

Undergraduate Education at Computer Science Department

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Abstract

The Computer Science (CS) Department of the University of California, Riverside (UCR) has a unique and diverse group of both students and faculty. The CS student body ranges in ethnicity, gender, and most importantly, their ability. As teaching assistants, it is our job to understand and leverage our positions as leaders and teachers, and to encourage growth and understanding of a given subject matter. In this report, we will discuss various strengths and weaknesses of the CS department and present suggestions for possible improvements. We present real world experiments to test and validate our conclusions.

1. Introduction

The goal of university education is to train high quality students. We always aim at helping students building a strong foundation of knowledge, so that after their graduation, the students will be able to apply and extend what they have learned into their jobs. Education improvement is always a concerned subject for educators. University always wants to make sure that the students have a good learning environment. As teaching assistants in the Computer Science Department of University of California, Riverside, we have some thoughts about the good things we have accomplished - so we can continue in that direction and do better – also the not so good things that we need to improve on. Our department is outstanding at

- leveraging diverse class sizes to help students build practical, varied, and needed skills for their future works
- offering a variety of courses which assists the students to develop ideas in software development and human interaction
- always trying to improve the environment in computer labs for students to learn, and for teaching assistants to teach

However, we have also recognized that there are areas of concern that we need to think about and work on them. These areas are:

- the negative effect of the grade curving and grade inflation style
- the maintenance of quality of instructors and teaching assistants
- and certainly the need of continuous improvement over classroom environment

In this report as we go through each point, we will state some suggestions that we think they are useful for the future development of the Computer Science department.

2. Strengths of Department

There are three main attributes in the UCR Computer Science (CS) department that readily sets its performance apart for other universities in terms of education and advancement of new educational tools.

2.1. Leveraging Diverse Class Sizes

The growth and overwhelming fluctuation in the size of the CS department has caused the department to both expand and shrink based upon the size of the student body. As a department, this has created a challenge for administration to not only handle larger class sizes, but also to retain current students during times of lower enrollment in the college. This produces as hardship on both ends of the spectrum requiring the department to dynamically adapt and use these changes to the best of their advantage. This ability is obvious from the ever increasing number of facility in the face of lower enrollment and the ever continuing strives to improve education and ensure smaller class size. From a teaching assistant standpoint, the ability to dynamically transition from large to smaller lab sizes is beneficial for both the students and the teaching assistants. From a student standpoint varying class sizes allow for more difficult

classes to be reduced in size while larger class sizes are leverage for group projects and peer participation.

Both types of environment contain unique aspects of education. For larger class sizes it encourages students to interact and perform in groups, where many large companies strive to use group models to development models such as XP (extreme programming). On the other hand, smaller class sizes provide a strong support and nurturing environment for students. This type of model allows students who require additional attention to obtain it will little or no additional time. When these two types of environments are leveraged properly such as in UCR, we are able to not only address modifications to class sizes, but also leverage the most ideal situations when available. This also encourages a broad range of education from both an intellectual as well as social aspect.

2.2. Development vs. Interaction

It has been a long standing tradition of computer science and engineers to embrace the idea of hard work in dark rooms. From this, they have been able to build discipline and acute understanding of our trade. This being said, computer science like many other sciences have evolved into the not only a technical skill but also a social one as well. Computer science as we know it has stepped outside of the dark rooms lit with computer tubes to become what we think of today as true technical and social professionals. It is not acceptable to graduate students who intend to program with no further dreams. A computer science program must embrace all walks of computer science from the technical depths of C++ to the social interaction of client based software development. With a complete skill set, students can not only perform equal to the peer but more importantly outperform the masses we strive to climb above.

The CS department at UCR has embraced just these qualities required to become a complete computer scientist. This is evident from the continual rigorous addition of new classes and seminars, and the increase encouragement of social interaction through the interaction of new classes such as software engineering. With these additions, students are able to form a concrete platform from which they can build their technical understanding, and augment this understanding by gaining the ability to interact and advocated their ideas clearly and concisely.

In addition, the usage of XP programming (group based development) is an emerging new trend being used by various large institutions to increase

productivity and decrease errors bugs. UCR again has jumped onto this new idea and introduced it into the curriculum as requirement for current students. Regardless, whether XP programming is beneficial or not, the direct impact for student graduating and moving into the work force is priceless because their ability to understand and assimilate into different development cultures is easier due to their broader understanding of different development environments.

2.3. Student Lab Environment

Student lab environment is a broad topic ranging from student computers to the lab itself. In all aspects the student lab in the UCR Computer Science department has been a continual place of improvement and changes, always pushing for better environment for students to learn and teaching assistants to teach. Combining these various aspects of lab environment contribute to the overall performance of undergraduate students in the UCR computer science department.

From the lab perspective, the resource provided in terms of computers and other computational resources has been a source for continual improvement ranging from continual migration to cutting edge technologies to the standardization of Terminal services technologies for lower division classes, to standardized installations and create a manageable environment for both users and administrators. One of the most notable achievements of the CS department is the interoperability of various operating systems including Microsoft Windows, Mac OSX, and other various distributions of Linux. Support for such a large array of operating systems provides an ample environment for students to experiment in various environments and technologies. From a teaching assistant stand-point the ability to use various tools and applications gives a wide leveraging factor for teaching assistants to illustrate different examples and ideas.

Lab environment is also strongly effected by the faculty and staff. Research has shown that the arrangement of chairs and tables can be a determining factor in helping students learn [1]. In the UCR CS department, we have spent much time listening to various faculty and staff regarding lab environment, which has sparked changes to the current lab structure including the addition of couches and chairs to provide a more comfortable environment where students can lounge around. This provides beneficial environment for students providing a sense of comfort and care for the labs. Distraction in a classroom has been a continuous issue with a lot of labs and classrooms that

provides internet access. Therefore, other improvements include the rearrangement of desks and computers to create a better environment for students to listen and become less distracted by other students and computers.

2.4. Summary

Some improvements which the department is currently testing are methods for giving teaching assistants control over all screens in a lab. This allows the teaching assistant to remove distractions from struggling students as well as possible broadcast exempling information such as code that student cannot see on the whiteboard. With the current improvements already made and the current changes as shown on the horizon is obvious the UCR computer science department is not only well equipped but also prepared for the future as emerge technologies become available.

3. Weaknesses & Improvements

Despite the excellence of our department as noted earlier, there are several areas in which we can improve on. In this section, we will discuss various departmental weaknesses in detail.

3.1. Effective Education

The quality of education offered by the department largely determines the quality of the department. Because of its importance, care has to be taken to maintain education at certain academic level. The department should ensure that the educators meet minimal qualifications as they are the primary provider of the education.

The department should supplement training for the non-native speakers. The instructors and TAs should have certain level of fluency in English in order to communicate with the students effectively. Even if the instructor is acquainted with the material, students will not be able to learn if the instructor cannot communicate. Currently, the Graduate Division requires that all TAs whose first language is not English to take an oral proficiency test and earn a score of 40 out of 60 or above in order to work as a TA. Following the exam, the proficiency is monitored by the evaluations from students submitted at the end of each quarter [3]. However, the policy of the Graduate Division does not clarify the consequence of having unsatisfactory evaluation results, nor does it mention if it will lead to dismissal from the position. To supplement the requirements and trainings offered by the Graduate Division, the department can offer additional trainings to ensure

certain level of fluency. Also, trainings specifically aimed at conducting classes in computer labs may be helpful as well, since it is quite unique compared to the discussion sections for courses offered by the other departments.

3.2. Student Quality

The department should put in more effort to improve student quality. As in most universities, UCR uses grade as the primary way to evaluate students. For the grades to be meaningful, it should reflect the level of understanding the students gained from the course [1]. However, there is one significant issue in the department that affects the validity of the grades and the academic quality of students: the use of grade curves.

Curving is a method used to adjust student grades and is usually aimed at raising the average score to a reasonable level. It is a common practice and is observable in majority of the courses offered by the department. However, despite the popularity, many of its uses are inappropriate. For example, in one of our classes offered here in UCR, a midterm was given with allotted time of an hour. The exam was of reasonable length and difficulty, as the students were able to finish the exam on time and the average came out to be about seventy percent, which corresponds to an average letter grade of C. However, the exam was curved in response to a single complaint from one student who achieved a low grade on the exam. As a result, the scores have boosted significantly, with a student originally scoring seventy-five receiving a ninety after the curve. Curving should only be used in cases where justification exists, such as when a three-hour exam is given in an hour-long class. Use of curving on other occasions will result in grade inflation, which triggers unwanted consequences.

Grade inflation lets students with inadequate knowledge proceed to higher level courses. Upper division classes have prerequisites to ensure that the student has the necessary background prior to taking the class. However, a student may have passed the required course as a result of curving, not because the student gained knowledge. It may sound unbelievable, but there are upper-division students who have no idea what polymorphism is or have never written more than a hundred lines of code. Such students will suffer later for not being able to understand the materials covered in advanced courses. In addition, the reputation of the department will be negatively impacted when these students get into workforce with insufficient knowledge. Therefore,

inappropriate use of curves is also harmful to the department.

In addition to when a curve is appropriate, how a curve is applied needs to be considered as well. Even if there is a justifiable reason to curve, the method used can make the curve unacceptable. For example, a curve should not be applied by simply multiplying the scores by two. It did happen in one of the classes, and the consequence was that the students expected the same to happen for all of the following exams. Many of them lost motivation to study, because their effort will not be correctly reflected on the grades. Again, curving leads to degradation of student quality.

To address this issue, the department should ban irrational curving. Any curving without a legitimate reason should be prohibited. Currently, there is no set standard on when a curve is appropriate and how the curve should be performed. Because the department only receives the final grades, there is no way to tell if the grade is based purely on the graded material or if some adjustments are made. To make the process visible, one suggestion is to require scanned exams to be turned in. It would be unrealistic to check all exams from all of the classes, so pick few courses randomly and check if the recorded grade matches with the original grade assigned. Or, to simplify the task, the history of changes can be stored by using some kind of versioning system, such as Subversion, to have the grade book versioned.

3.3. Classroom Environment

Classroom environment plays an important role in student's learning. An environment consists of everything inside the classroom, such as people, desks, computers, and effective management of them is necessary in establishing comfortable environment for students to acquire knowledge.

One of the improvements that the department can make is to minimize distractions caused by students. Currently, the computer labs are used both as a classroom and as an open lab, with no policy to prohibit students from walking in to the labs while a class is going on. As a result, outsiders can freely enter the lab, take up a computer, and make noise. Although the TA has the right to ask the outsider to leave, it will take some time to walk up to the outsider and ask for a leave, the time which can be used for lecturing otherwise. Consistent interruption in the midst of an explanation may confuse students and disrupt concentration, negatively affecting their ability to absorb the material. To resolve the problem, the department can have a separate open lab for the

students to work on the assignments. Then, the labs used for classes can be closed up, free from the outsider intervention.

Unfortunately, outsiders are not the only cause of distractions. In fact, students who belong to the class can cause disruptions as well, usually in the forms of having conversation with their peers. As the large class size tends to make class management harder, the department can support the instructor by having small-sized classes. It also benefits the student by giving them more individual attention than with larger class.

Another areas in which the department can improve is the computers in the labs. While the computers are necessary for the students to work on the assignments, they are not needed for them to take notes. Indeed, having computers can even cause distraction among the students by allowing them to engage in chat rooms and play online games when they are supposed to be listening to the lectures. As in the outsider case, it also leads to the reduction of concentration, so some action needs to be taken to confront the problem.

There are several ways to approach the issue. One approach is to have a separate room for the TA to lecture. If the room does not have any computers, then distractions from them cannot occur. Once the lecture is over, then move back to the lab so the students can work on the assignments. Although it meets our need, the time it takes to move from one room to the other may be significant, especially if the rooms are far apart. Another slightly more sophisticated approach that is practiced in many colleges and universities is to let the TA control all monitors in the lab. The TAs can freeze all monitors or shut down the computers in the lab if necessary, preventing students from engaging in activities not related to the class. Giving control not only reduces distraction, but it also has positive side effects. For example, allowing the TAs to transfer their screen to student's computers makes demonstrations to be performed easily. It will solve the problem of using projectors, where some students may not be able to see the screen well. The only problem with this is that it will take some time before such system becomes available.

There is one simple approach that can be performed immediately. The TAs can instruct the students to turn off the monitor or bring the chair up to the front until the lecture is over. This way, students will not have the access to computers just as if the computers are not present. The approach does not take up invaluable class time and also does not require

any additional equipment. Although it does not have the positive side effects as in controlling computers approach, it suffices to serve as a temporary solution to the problem.

The department should put effort into removing possible cause of interruptions. In fact, one study shows that often, about thirty percent of the class time is lost due to interruptions [2]. Minimization of such a significant cause of time loss will allow lectures to be presented smoothly, enhancing the clarity and understandability of the lecture.

3.4. Summary

In this section, we have explored possible areas of improvement in detail. We hope that the department will put serious effort in facing the issues, as it will lead to the betterment of the department and as a consequence, to the betterment of the university as a whole.

4. Experiment

After consideration, we decided to begin the experiment in a lab environment. Our hypothesis is that without the distractions (from computers as well as from students) the students will understand the lab material better. The number of subjects in our experiment consists of students who attended their labs on May 17th, 2005 and May 24th, 2005. Six students attended May 17th lab, and three students attended May 24th lab.

The small class size was chosen because our research focuses upon upper division core courses. We felt there will be too much distraction from other class influences, and deviation in terms of curriculum to provide meaningful results for lower division or elective upper division courses. All of our results are taken from CS152 for the spring quarter of 2005.

Distractions from computers and from students were minimized for the May 24th class. To avoid students from surfing the web or playing games, they were not allowed to log on to their computer. In this class, the lab was also left exclusively for students who are currently enrolled in this lab. Other students from other labs or classes were not permitted into the lab. On the other hand, the students from the May 17th class did not need to change any of their habitual class time. They were left to do what they have been doing since the beginning of the quarter. For both of the labs, the introduction of the lab assignment took place at the beginning of the lab, and the quiz consisting of questions related to the materials covered in the lab was given afterwards.

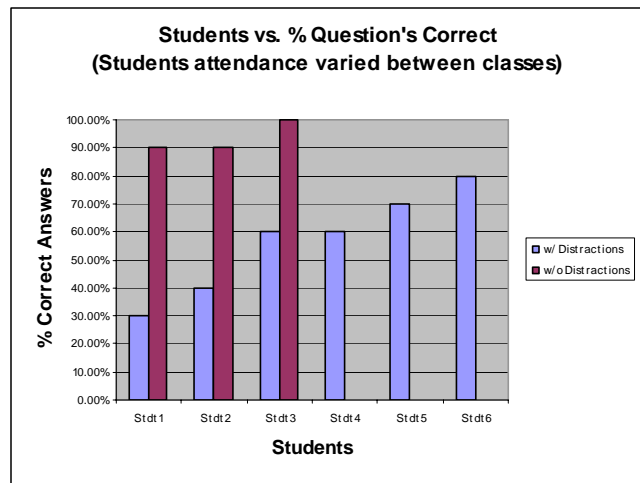


Figure 1: Effects of distractions vs. reduced distractions in a lab/classroom environment

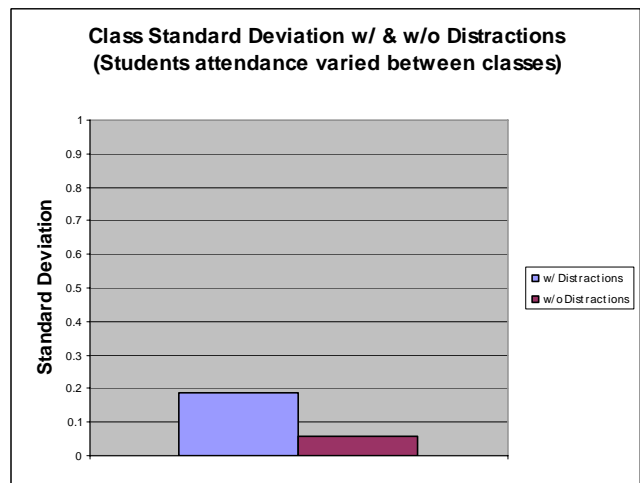


Figure 2: Effects of student distractions on deviation of class performance

Our results show that as the distractions were removed from the lab setting, not only do individual student's performance improve, the class as a whole performed better as well. Overall improvement is most likely improved due to the fact that as distractions are removed from individual students, it reduced distractions caused by a student affecting the entire class. By removing these issues, we can conclude that the removal of small distraction can in fact benefit the entire class.

5. Results

The quiz which was given to both days' students was graded in the scale of 10. As we expected, the results have proved our hypothesis. May 17th's lab quiz scores distributed in a wide range, from 3 to 8; and the average was 56.67%. The standard deviation is at 0.18619.

In contrast, in the quiz taken on May 24th scored a smaller range from 9 to 10, average score is 93.3%. The standard deviation is at 0.057735.

The huge difference in the result may be influenced by some factors as well. Since fewer students attended the lab on May 24th, it may be that out of the six students who attended the lab on May 17th, only those who had desire to listen came to the lab. The possibility is supported by the facts that the lab is offered early in the morning and that the lab attendance is not part of the grade. Also, there may be some difference in the difficulty of the quizzes. Since the quizzes were written by a non-expert, the questions on the May 17th quiz may be harder than the May 24th quiz as it requires some practice to write quizzes of consistent difficulty. Despite some biasing of the result, the result still shows positive correlation with our proposal.

6. Conclusion

In our research, we have found that by removing any distraction from a lab environment is beneficial for the students. Their quiz results have made a tremendous difference in comparison with the class that did not remove any distraction from the lab. The distraction in a class environment is an obvious issue in lab and classroom settings. Another observation is that with the influence of one student cooperating with the teaching assistants, it also influenced their peers in the same class. The problems we were not able to control are the class size of both classes. The results will vary if the class size was bigger. Even with the distraction level brought to the minimal in a class size of up to 20 students, the number of students in the class might add different type of distraction which the teaching assistant cannot control. For example students conversing between themselves while the teaching assistant is teaching. In future research, it will be interesting to see the same technique used in a different department, for example, in the Physics or Chemistry department. Would the distraction level reduce to the minimal by removing necessary distraction? These classes have one thing in common, distraction from all dimensions. If most of these distractions can be removed, would the students' quiz result show a difference as compared to our research? There are many directions this research can head into but for the purpose of our paper, we have found that by removing necessary distraction does affect the retention skills of the students.

7. References

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