

Title: Cross-level Peer Mentoring

Author Name: Sanjay Goel,

Jaypee Institute of Information Technology, Noida, India

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CROSS-LEVEL PEER MENTORING

SANJAY GOEL

Computer Science and Engineering

goelsan@yahoo.com

With increasing demand for engineering education in India, the class size has become larger, and it continues to increase. Universities and colleges are finding it increasingly difficult to build enough faculty capacity to provide a long term individual attention to all students. According to a recent UGC report ¹ during 2004-2009, the growth rate of faculty has been substantially slower than the growth rate of universities and colleges, and the growth rate of students. During this period, overall students-teacher ratio in Indian higher education system has worsened from 21.7:1 to 23.1:1. Worldwide good institutes of higher education maintain a generous students-teacher ratio of 6:1 to 10:1. In India, the prescribed ratio for premier institutes like IITs is 9:1. In reality, this ratio has gone up to 15:1 at many IITs. The UGC has recently revised its norm and asked the universities to maintain a ratio of 25:1 for many undergraduate programs.

Personal attention to every student is perhaps the most important aspect of good education systems. ² It is even more important for students with average and below average academic performance. In the famous classical Oxford-Cambridge system, teaching is primarily done through a tutorial system in which the faculty takes weekly tutorial sessions with 1-3 students. Poor students-teacher ratio seriously affects the quality of laboratory work and hands-on practice in engineering courses. A few highly motivated students are able to overcome this limitation by building their own network among working professionals and/or senior students. However, the majority finds it difficult to cope with the challenges of laboratory work without support from more experienced persons. As faculty cannot simultaneously guide so many students, they also develop a reluctance to increase the amount and complexity of the laboratory work they give to students. Hence, in real practice, at many institutes, the students do not get sufficient challenge and practice in software development. A few hours of weekly engagement of senior students in mentoring junior students can greatly supplement faculty efforts to enhance the technical competence of a much larger number of junior students. This paper describes our experiment with cross peer mentoring for the last six years, and makes a case for introducing it as a conscious student teaching/learning strategy in the engineering curricula across the country.

Tradition of Mentoring at Workplace

The concept of mentoring the juniors, during and after qualification, is a well established practice in many professions like medicine, nursing, law, chartered accountancy, social work, school teaching, etc. Mentoring has been defined ³ as “a process of informal communication, usually face-to-face and during a sustained period of time, between a

person who is perceived to have greater relevant knowledge, wisdom, or experience (the mentor) and a person who is perceived to have less (the protégé).”

Organizations use it for widening the skills base and competencies of their employees in line with their strategic goals, and find it a cost effective form of personal development. It also improves teamwork and cooperation in organizations. Mentees get benefitted by mentor’s support in many ways: analysis and reflection, problem solving, self-confidence and ability to take risks, acceptance of criticism, as well as broadened horizons and maturity. On the other hand, teaching has been well recognized as one of the most effective ways of learning. We create deeper understanding and clarity for ourselves by teaching others. Mentors also draw several benefits ⁴ by mentoring others: improved awareness of the gaps in their own learning, ability to give and take criticism, leadership, organizational and communication skills, ability to challenge, stimulate and reflect, and stimulation.

Reflections of Software Professionals

In 2009, a feedback was collected from LinkedIn, the working professionals’ online community. They were asked the question “How did you benefit from your first experience as a mentor/coach/guide?” They were also requested to critique the idea of making mentoring compulsory for all final year students. Twenty-seven professionals (excluding our own alumni) belonging to diverse countries and age groups responded. An overwhelming majority of these respondents enthusiastically supported the idea and also identified many very significant learning outcomes from their own first mentoring experience. A few excerpts of some of the identified learning outcomes from the personal experiences of working software professionals were:

- “Great sense of satisfaction.”
- “My learning grows exponentially by coaching or guiding someone. Fresh perspective to your own outlook. It forces us to think about things critically so that we can explain it to someone else. I have found personally that mentoring forces me to grow, and usually benefits me more intellectually than the recipient.”
- “I learnt more about myself, the decision making process, individual differences, and of course communication skills.... We get multiple perceptions.... I learned how valuable diversity was for success.”
- “I found that I was required to look within myself and develop patience and empathy.”

Cross-level Mentoring: Our Experiment at IIIT

At Jaypee Institute of Information Technology (IIIT), cross-level peer mentoring was initiated in 2005. Over the years, it has expanded in size and evolved in structure. During 2005 to 2011, more than 1000 students have mentored their juniors under this initiative. Most of these students have played the roles of mentees as well as mentors in different years. During 2005 to 2008, a total of 164 final year undergraduate students were engaged in mentoring their junior students in laboratory work as part of their formal assignment in ‘Learning Sciences’ or ‘Theory of Knowledge, Learning, and Research.’ They assisted the concerned faculty in the laboratory classes of many host

courses offered to first and second year students. These host courses included courses like 'Introduction to Programming,' 'Data Structures,' 'Multimedia Laboratory,' 'Unix laboratory,' 'Data base management Systems,' etc.

In the presence of concerned faculty of the host course, they provided guidance, clarifications, clues, and support to needy junior students. Junior students were freer with the mentor as mentors were not judging them for grades. Many enthusiastic mentors were always moving from one student to another trying to clarify their queries. If unable to solve some problem, they happily referred their mentees to other mentors. Juniors did not hesitate in asking questions and weaker students got individual attention from their mentor. Cases of plagiarism also reduced.

The mentors of 'Introduction to Computer Programming' have reported helping their mentees in removal of syntactical errors, problem understanding, programming logic development, mapping logic to programming language constructs, debugging, providing study resources, project formulation, etc. More than 70% of these mentors claimed that they revised the old content of the host subject, and also learnt the new content that was added for the juniors, through self study. More than 70% responding mentors claimed to provide regular support to a few of their mentees even outside the scheduled contact time. Some motivated mentors took some special initiatives like creating online communities of their mentees, or regularly holding discussion with their mentees after the scheduled hours. Sometimes, mentors also discussed their mentee's problems with other mentors.

In 2007-08, a selection of 40 students of another fourth-year elective course, 'Software Engineering Management', were engaged to mentor juniors' second-year combined project in 'Object-Oriented Programming' and 'Database Management Systems,' as part of their project management practice. In 2008-09, all 200 students of this course group-mentored five credit minor projects of third-year students. These final-year students mentored the projects to build tools in diverse areas of software engineering. The mentors submitted weekly mentoring reports. According to the feedback received from the faculty of host courses, nearly 65 to 70% mentors provided good help to the mentees. In the same semester, through the facilitation of the 'Software Engineering' course, a total of 205 third-year students were engaged as project mentors for mini projects of juniors. In the second semesters of 2007-08 and 2008-09, when the mentor facilitating courses were not operational, many students of the final year, and also the third year, volunteered to mentor the juniors' laboratories even without credit.

Based on our earlier positive experiences, very encouraging feedback from industry, and consultation with faculty members of the Department of CSE and IT, in 2009-10 and 2010-11, more than 600 final year B.Tech (CSE) and B.Tech (IT) students were compulsorily engaged to mentor laboratory work and projects of approximately 3,000 juniors. Mentoring was considered as an integral part of their day-to-day work for a mentor's own year-long final year capstone project that is assigned more than 10% credit of the entire B.Tech. program. More than 40 faculty members, who were also the project supervisors of these final year projects, agreed to keep 10 marks (out of the

supervisor's quota of 35 marks) earmarked for the day-to-day work of the first semester of the final year ⁵.

The feedback received from host faculty, facilitating faculty, mentee students, and mentor students during different stages of this scheme's implementation was positive. In 2007, a survey was conducted among the faculty of the CSE and IT departments. *Most of them felt that it provided benefits to mentees as well as mentors.*

In their opinion, mentees got benefits like increased level of instructional help and clearing of doubts, increased opportunities for one-to-one out-of-class help, improvement in problem solving approach, and increased comfort levels with the subject. The faculty members of the facilitating course, 'Software Engineering Management' felt that mentoring had provided their students a better understanding of the role of human factors in software engineering. It improved their project management, team management, leadership skills, their problem understanding and problem solving abilities. The other benefits in their view included healthier cross-level relationships between cross-level students, and also increased the confidence of the mentors. While a few faculty members also expressed their concern about the risk of increased spoon feeding of the juniors and discipline, the majority expressed their desire to continue the scheme of mentoring juniors.

Mentee Students' Reflections

Topping and Ehly ⁶ argue that peer-assisted learning works well for the mentees because it offers them easy access (quantity and immediacy). In 2007, a blind feedback survey was conducted among approximately 200 second-year mentee students. Students gave an average rating of more than 80% to the mentors based on the extent of help provided by them. This average rating was higher than the general average rating given to faculty by the students through a blind feedback collection mechanism. The mentees felt the benefit of easier accessibility and friendly guidance.

Through mentoring, a large number of mentees established good relationships with their mentors. This relationship also helped them in many academic and other kinds of decision making. Most of them continue to consult their mentors even after their graduation.

Mentor Students' Reflections

As the seniors guided the juniors, they engaged in explaining, answering questions, correcting mentee's errors, and manipulating different representations. This provided them opportunities not just for rehearsing their knowledge, but also for reflective knowledge building by recognizing and repairing their own misconceptions, and gaps in knowledge, integrating new and prior knowledge, and also generating new ideas⁷. They started asking questions related to 'how,' 'why,' and 'why not.' It helped them to visualize the same concepts from another perspective. This helped them appreciate the interrelationship across courses. It helped them in debugging their work in programming-oriented laboratories, and gave them the practice of reading and comprehending foreign code.

Mentors reported⁸ several other benefits for themselves: experiencing joy and satisfaction, enhanced confidence, self-esteem, and hence, enhanced motivation for more challenging work in their final year project, improved understanding of self and others, development of patience, empathy, and out - of - box thinking, improvement of analytical and debugging skills, insights for project management issues, handling quality and late delivery, and also enhancement of communication, collaboration, leadership and decision making skills. Many of these benefits were very similar to the benefits from mentoring at workplace as reported by the working software professionals. In another survey, conducted in 2009, among more than 300 final year mentors, nearly 95% respondents felt that mentoring juniors was resulting in their own multi-dimensional learning of various kinds that will be useful for their future career. Some of their comments regarding their own learning gains through mentoring of juniors are given in Appendix-I.

Reflections of Former Cross-level Mentors (Alumni)

To corroborate these responses we also conducted a survey among alumni of JIIT in 2009. The purpose of this survey was to understand the learning gains from the mentoring experience. Many of the responding students were among the toppers, and the best programmers during their college days.

Many of them felt that in comparison to with all other academic engagements, mentoring the juniors was the most effective in terms of its effect on development of several competencies. Most significant learning benefits were experienced with respect to the development of some core competencies like accountability and responsibility, communication skills, and the ability to accommodate self to others. Its positive effect on several other competencies were similar to those experienced by other current and part JIIT mentors. More than half of these respondents stated that they are still in touch with their former mentors. Some comments of alumni respondents are given in Appendix-II.

Cross-level Peer Mentoring in Higher Education: Some Other Experiments

Since the 1970s, University of Missouri-Kansas City has been running an academic assistance program, called Supplemental Instruction (SI). SI that utilizes peer-assisted informal study sessions. The sessions are facilitated by 'SI leaders,' students who have previously done well in the course, and who attend all class lectures, take notes, and act as model students⁹. Researchers have reported that 75.8% of medical schools in USA had near-peer tutoring programs^{10,11}. Since 2005-06, University of Calgary, Canada has been running a course 'Collaborative Learning and Peer Mentoring' for fourth-year undergraduate students¹². This course includes 40 hours of practical experience of 'curricular peer mentoring' and weekly discussion sessions of 2.5 hours. Enthusiastic students are offered a second opportunity to mentor through another course 'Advanced Peer Mentoring.' Students of the second course are also engaged in mentoring the new peer mentors. These studies have reported several benefits to the mentees: reduction in the dropout rates, improved academic performance, alternate explanations, and enhanced confidence of junior students. A few Indian institutes like IIIT, Hyderabad and IIIT, Delhi are also engaging their selected senior students to mentor their junior students.

Why Cross-level Mentoring Benefits Mentors

As per 'adult learning theory'¹³, adults are motivated to learn by six factors. In addition to external expectation, personal advancements, and cognitive interest, these factors are building social relationships, engaging in social welfare, and stimulation, i.e., contrast from routine work. Mentoring opportunities offer all these six factors. Hence, it offers a wholesome learning opportunity to the mentors.

Some faculty members have observed that sometimes even those students, who had not performed well in their course as regular students, in a later semester, take their mentoring task for the same course very seriously and do an excellent job.

As per the 'cognitive flexibility theory'¹⁴, revisiting a subject with different issue questions makes the learnt matter more easily transferrable to unfamiliar problem situations. Mentoring gives senior students an opportunity to revisit an earlier course, laboratory course or project from a different objective, higher level of maturity, and richer background of various other related courses. It engages them in rehearsal as well as elaboration of the host subject's concepts, technical skills, and applications. The act of explaining the subject to juniors requires the mentors to create novel examples, analogies, and expressions. In addition to advising their mentees on assigned problems, many motivated mentors often also design additional problems for them. The act of guiding them in project formulation, scoping, and design helps them to validate their own project experience. While many of them had earlier approached the subject with limited focus on inter-linkages between different concepts, the mentoring experience facilitated them to do so now.

Conclusion

Hence, we conclude that cross-level curricular peer mentoring has multi-dimensional effects on mentees as well as mentors. Instead of viewing it as a strategy to partially overcome faculty shortage for junior level courses, it should be viewed as a necessary educational experience for seniors that helps them enhance several of their own competencies.

References

- [1] *University Grants Commission, Higher Education In India: Strategies and Schemes during Eleventh Plan Period (2007-2012) for Universities and Colleges*, p 3. January 2011.
- [2] Benjamin S. Bloom, "The 2-Sigma Problem: The Search for Methods of Group Instruction as Effective as One-to-One Tutoring", *Educational Researcher* 13 (6), pp 4–16, May 1984. Bloom argued that about 90% of the tutored students achieved the level reached by the highest 20% of the students of a conventional class of 30 students. He also found that with respect to problem solving, application of principles, analytical thinking, and creative thinking, the average tutored student was above 98% of the students of the untutored group.

- [3] B. Bozeman and M.K. Feeney, "Toward a Useful Theory of Mentoring: A Conceptual Analysis and critique. *Administration & Society*" 39 (6), pp 719–739, October 2007.
- [4] Judy McKimm, Carol Jollie and Mark Hatter, *Mentoring: Theory and Practice*, 2007, retrieved from http://www.faculty.londondeanery.ac.uk/elearning/feedback/files/Mentoring_Theory_and_Practice.pdf.
- [5] Sanjay Goel, "A Learners' Pyramid: Undergraduate Mentoring in Software Engineering", in Tania Smith (Ed.), *Enriching Courses with Undergraduate Peer Mentors: Theory and Practice*, McGill-Queen's University Press, Canada (In Press), 2011.
- [6] K. Topping, and S. Ehly, (eds). *Peer-Assisted Learning*. Routledge, pp 1-25 1998.
- [7] Rod D. Roscoe and Michelene T. H. Chi, 'Tutor Learning: The Role of Explaining and Responding to Questions', *Instructional Science*, Volume 36, Number 4, pp 321-350, July 2008.
- [8] Sanjay Goel, "Some Reflections on Cross-level Mentoring", 2011, <http://goelsan.wordpress.com/2011/06/30/some-reflections-on-mentoring/>
- [9] University of Missouri-Kansas City, The International Center for Supplemental Instruction website, Retrieved from <http://web2.umkc.edu/cad/SI>.
- [10] M. Moore-West, S. A. Hennessy, P.W. Meilman, ,and J.F. O'Donnell, "The Presence of Student-based Peer Advising, Peer tutoring, and Performance Evaluation Programs Among U.S. Medical Schools". *Academic Medicine*, Volume 65, pp 660–661, October 1990.
- [11] M. Tai, Patricia O'Sullivan, Arianne Teherani, and Jessica Muller, "Understanding the Experience of Being Taught by Peers: The Value of Social and Cognitive Congruence", *Adv in Health Sci Educ*, Volume 13, Number 3, Springer, pp 361–372, August 2008.
- [12] Tania Smith," Integrating Undergraduate Peer Mentors into Liberal Arts Courses: A Pilot Study", *Innovative Higher Education*, Volume 33, Number 1, pp 49-63, June 2008.
- [13] K.P. Cross, *Adults as Learners*. San Francisco: Jossey-Bass, 1981.
- [14] R.J. Spiro and J. Jehng, "Cognitive Flexibility and Hypertext: Theory and Technology for the Non-Linear and Multidimensional Traversal of Complex Subject matter". In D. Nix & R. Spiro (eds.), *Cognition, Education, and Multimedia*. Hillsdale, NJ: Erlbaum, pp 163-205, 1990.

APPENDIX-I

Advantages of Mentoring as Identified by Final Year Students Involved in Cross-level Mentoring of Juniors, 2009

1. Good revision of all fundamentals and some good genuine doubts solutions. Learning some new technologies. Keeps me updated.
2. Software quality and testing concepts along with designing. I have clarified my concepts on requirement engineering which has helped me in my final year project report.
3. Unique addition to my ability. Broadened our mental skills.
4. Patience and listening. Communication skill in explaining ourselves to others. I am much more expressive now and can explain and present things better. Think more and think in line with the people working with me and in my surroundings. Be more receptive to the problems of others.
5. How to approach towards a given problem. ... into every problem in different ways and help us to find various solutions.
6. Deal with my subordinates. Built my leadership quality a lot. Quality of working as a team leader and resolving the problems faced by the people/inculcating qualities of a project manager. Improved leadership skills, multiple perspectives. I am gaining on mentoring skills and ways to communicate a problem to different people. I can now understand the problems which a newcomer faces. Building rapport with different kinds of students, understanding others; code, taking responsibility.
7. Enhancing my teaching skills. I have found a teacher inside me. I want to become a lecturer so it's helping me understand the student mind. It would definitely aid me in applying for teaching assistantship.
8. Now that we are going to sit for placements, it's very important/will definitely help me in on campus selection.

APPENDIX-II

Advantages of Mentoring as Identified by Alumni

1. Questions thrown up by the mentee sometimes made me look deeper for some concepts to which I had never paid much attention earlier. One is able to find out gaps in knowledge and determine understanding of the subject.
2. I had to explain them in a simple manner. Communicate effectively, use and upgrade his own skills. Improved my ability to present the same topic from different angles.
3. Best thing I learnt was to look at the other side of the coin. Ability to move from macro to micro details and vice versa, patience and openness to critically analyze alternative approaches. I realized that every problem could be solved through different techniques. Mentoring helps thinking out of the box ...
4. Makes you feel like a bigger person. Makes you believe in yourself. Instilled a sense of an extra added responsibility. Mentoring provide inner satisfaction. Makes you a better person. You have to critically analyze the drawbacks and tradeoffs and justify your advisee,
5. The decision making and project management skills that got polished during the mentoring really helped me in long term.

6. As we advanced to senior years of the program, it was our responsibility to keep the custom alive by mentoring our juniors and honestly, the experience this time, was much more intense in this phase... as today, while working with some great researchers & highly qualified professionals, it is a must to present our opinion in a very crisp and simple way.