Measuring the impact of a learner centric pedagogical technique for a core competency of a course in Data Base Management Systems.

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Abstract—. **Computer Science Education faces two major problems – one being the continuous evolvement of the discipline itself, and, secondly, the issue of appropriate employment of graduating students. Instructors and educators need to periodically reinvent and restructure their curriculum to keep their learners abreast. An effective approach is to structure the curriculum by defining the requisite competencies as the instructional goals and subsequently defining the conceptual requirements to achieve these goals. When the outcomes of learning are clearly specified, activities must be designed and assessments logically done to confirm to what degree the required learning has been achieved. Certain instructional pedagogies may help students to acquire the mental processes for learning more efficiently, and to ably analogize and annotate the acquired skill. Thoughtful and detailed planning, understanding of the stakeholders and their needs, and an appropriate testing and feedback mechanism can maximize the benefits and minimize the negatives of a learning environment. This paper describes a study performed on one such learner centric pedagogical approach. The results of this analysis are expected to throw light about the impact of a competency based activity in the presence of a homogenous group formation. The paper describes the implementation and examines the learning effectiveness of a collaborative, peer-reviewed, learner-centric activity based instructional design approach for a core competency in a course on Data Base Management Systems at the Masters Level program in Computer Science.**

Figure 1. *Keywords—Computer Science Education; Pedagogical technique;, Learner Centric Activi, Group Compositio, Collaborative Learning.*

I. INTRODUCTION

Continuous and significant changes in computer science technologies create considerable pressure on academic institutions to keep the curriculum current and relevant. Operationally, it requires frequent revisions of course design. Academically, it requires research and understanding on how students learn new topics and how these topics are interrelated. When a systematic framework is provided to develop and deliver courses and supplementary activities, students will learn more effectively. The curriculum design should thus include effective learning processes and strategies characteristic to that discipline. In [11], Schroth et al does a comparison of various pedagogical approaches. Their results have shown that students experience more value, enjoyment and long-term influences of these activities as compared to taking exams and writing papers, which were viewed as neither valuable nor enjoyable. One such approach to effective and sustained learning and which uses multiple intelligence levels of the learner is the Collaborative Learning approach. This pedagogical technique helps team members to evolve as they need to arrive at a common consensus after evaluating, assimilating and synthesizing both complementary and supplementary information coming from their individual knowledge bases.

Because firms shift their IT strategies and tactics in response to competitive conditions, they want employees with multiple skills or competencies. IT faculty need to face the daunting task of educating professionals in the technologies and methods that will let students pursue proficiency in more than one skill area, and yet be flexible and easily updatable for future innovations. Furthermore, employees are valued for their ability to handle multiple roles, not for having an extensive mastery of only one role. Traditional IT curriculum planning does not envisage such a flexible and responsive structure. Collaborative learning results in acquisition of a broader range of skills through interactivity with others, a pre- requisite for sustainable employability in an application development environment. In a collaborative learner centric instructional delivery approach, groups of learners and their facilitator work in a more complex environment in comparison to a lecture-based delivery. They take on roles, contribute and opine on ideas, critique each other's work, and together solve aspects of larger problems. It is a well researched and a known fact that this approach to learning has associated benefits [3], [7].

There are various facets that need to be looked into for Collaborative learning to be effective. In [5], Gaffney and Nelson reflect on the requirements of several critical components: organizational arrangements, peer leadership and training, materials that are challenging at an appropriate level, and integration with the overall

course. Intelligence, personality and learning styles are factors that can influence a student's individual and collaborative learning. Obtaining conclusions regarding the effect of these parameters on the learning process would make it possible to consider them for the creation of better learning environment.

Barker [1] forewarns that simply requiring students to work in groups does not necessarily lead to improved learning outcomes. Reasons that could prevent a positive attitude to group work include fear of plagiarism, freeloading, ego, effort, and communication overheads [2]. Further, evaluations based on group performance may lead to anomalies in individual assessment. On the strength of the above research, it is important that academicians use group work as a means of active learning rather than for assessments.

There are several factors by which academics can choose groups. Researchers [12], [4] state that the rich and diverse back-grounds of members in a heterogonous group make them potentially more capable of solving group problems and perform more effectively than those in a homogeneous group. Relatively later researchers also reveal that heterogeneous groups will tend to function better than homogeneous groups [1], [8], [9]. Most of these studies indicate that groups composed of mixed achievers increases the knowledge base, the analytical and evaluator levels brought to bear on the problem, and consequently, the likelihood of a more optimal solution. This is notably true where the measurement is the consolidated overall group achievement, but what must not be neglected is the need to measure the improvement in learning, especially at the individual levels, which may not require the same group dynamics. A study done by Webb [13] is indicative of the fact that group composition can affect individual and collaborative learning. The study reveals that high and low ability students had an increased teacher/student relationship which increases verbal interaction, whereas medium ability level students engaged in less interaction. Interactions of these students changed dynamically when placed in heterogeneous groups. Studies by [6], [12] indicate that mixed ability groupings relatively disadvantage more capable students and tend to benefit below-average students.

This paper reveals a study and the impact of one such pedagogical technique for a core competency chosen from the curriculum design framework of a Data Management course. The study also addresses intrinsic, though subjective, concerns raised earlier regarding issues such as: the level of enjoyment during the learning process, the amount of contribution of the individual in the team, the improvement in the cohesiveness of the group and more importantly, the increase in the amount of individual learning. Conclusions are drawn through an analysis of the students' feedback and by statistically analyzing the data collected from the assessments performed on the learners over a period of three consecutive years, and, by the same faculty. The results of this analysis could serve to inform and advise an instructor in selecting an appropriate facilitation strategy.

The paper is organized as follows. Section II describes the methodology followed in the Instructional Delivery approach for the core competency. Section III describes the Implementation of the activity and Section IV is devoted to analyzing the performance of the learners under the influence of this activity. Section V concludes with a discussion on possible issues and enhancements.

II. THE METHODOLOGY

The Masters in Computer Application Degree Program at the Goa University offers a course on DataBase Management Systems in the third semester of its structure. The main objective of this course is that a student should be able to evaluate a business situation and, if feasible, build the database application in an RDBMS. Further, being a First Level Program where the candidates admitted to this course come from multiple disciplines of study, the course is targeted at the Intermediate Level. "Conceptual Database Design" being a core competency required in a DBMS course, was chosen as the module for this activity. The learning material stemmed from [10] Audience: Application Developers; Content: Module2 (IL), and was covered through lecture delivery and interactive activities (for knowledge and skill acquisition).

The differences between a discipline-based and a competency-based education must be taken into account when planning the learning environment. An integrated approach whereby a competency is achieved by defining the essential knowledge that is required, and by assessing the required skills and attitudes of students is a way forward. Competencies based Models target crucial skills and practices that directly contribute to an organizations goals. Once the skills and knowledge that form a competency model have been developed, the amount of the skill or knowledge required to succeed must be determined by the organization and relevant stakeholders. The Performance Measurement and Feedback Systems, besides ensuring an effective alignment of a programs objectives and the actual industry requirements, must monitor the effective teaching and learning process towards the achievemnt of the predetermined course objectives. Assessment efforts should not only determine whether students are acquiring the specified competencies but should enable students to visualize the desired level of performance and provide feedback for continuous growth and improvement. Learners should also be given the responsibility to learn by themselves. Individualized self learning, in the form of seminars and presentations, plays an important role in making this

transition. Figure1 captures the envisaged Life Cycle of the Teaching – Learning process in the competency based curriculum framework.

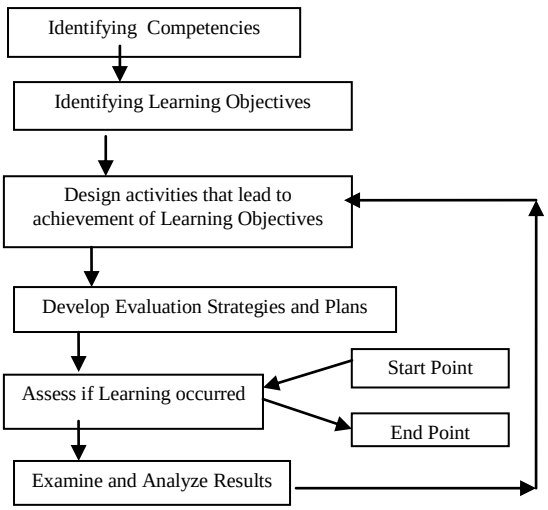


FIGURE 1: LIFE CYCLE OF TEACHING A COMPETENCY

While evaluating a competency, an absolute marking system of percentage marks is insufficient as it does not provide a measure of the level of a learner's ability for the specified competency. Competency Based Assessment measurements of 'Competent'/'Not yet competent' or Pass/Fail are also insufficient to determine the strengths and weaknesses of a learner. Although this removes the fear of failure for lower achievers it ignores the efforts of higher achievers. The competency evaluation process must be an indirect measure of performance, and used to provide indicators of students' perceptions of their own competency or performance level. Grading scales provide teachers and potential employers with a more appropriate mechanism to measure and motivate employees/learners. A Grading Scale which a student could readily identify with was used:

0: Doesn't know anything (guesses answers).

1: Knows something but is very confused (cannot justify the answer properly).

2: Knows something but some confusion still exists (answers may not be optimal, but can reason out the answer).

3: Sufficient amount of knowledge (can analyze and identify optimal solutions. Clear understanding and has marginal errors in solutions).

4: High Level of Knowledge (can generate and evaluate multiple alternative and accurate solutions).

Scales of 0 and 1 would imply that the learner cannot perform the competency (implying a repeat of the Learning Process). Scales of 2 and 3 imply that the learner can perform the competency but needs guidance. A Scale level of 4 would mean that the learner can perform the competency efficiently. To be able to pass the course, the learner must achieve at least a Scale of 2 in all the competencies stated in the course.

III. IMPLEMENTING THE ACTIVITY

The faculty conducting the course in DBMS has been facilitating a learner centric group activity for the "Conceptual DataBase Design" competency module over the last few years. Teams are given the work of analyzing an application and presenting their design to their peers. The peer teams would grade the presentations, which were interspersed with questions, discussions and constructive criticism, based on parameters given to them by the faculty. This proved to be very useful activity as the learners were made to note the pros and cons of a design choice in different application scenarios. The learners also enhanced their ability to synthesize and connect material to their existing knowledge base. This process of integrating information gave them a much deeper understanding of the subject. The faculty would then grade the reviews of the peer review teams to assess the evaluation skills of the teams conducting the peer reviews.

Data collected for this study ranges over a period of three years (2007 -2009). In the earlier years, i.e., prior to 2009, the teams which were formed were heterogeneous in nature (viz., learners with different grade levels and learning styles were in the same group). The case studies that were presented to them for analysis, design and peer reviews were of the same complexity levels. The approach taken in 2009 differed in the following ways:

(i) A Pre-test was conducted before the commencement of the formal lecture sessions and activities for this concept.
No marks were allocated for the pre-test; instead a maximum time limit that a student needed to spend on each question was specified.

(ii) The groups that were formed were homogenous – i.e. students with similar academic performance levels at the pre-test, aptitudes and attitudes as perceived by the faculty, were made a part of the same team.
This was done with the intention of obtaining the maximum participation of each learner in his/her group.

(iii) Case Studies of varying complexity were given to the groups.

(iv) Students were allotted individual points for the "amount of learning" that took place between the Pre-test and the Post-test.

A. The PreTest

The conduct of the Pre-Test was done to gauge the existing individual knowledge base and to calculate the amount of individual learning that would take place for this competency. The pre-test was possible as the students were from the third semester of the course and had undergone an intermediate level course in DBMS at the

undergraduate level. The question paper had sections encompassing all levels of Blooms taxonomy. A feedback taken after the Pre-test conformed that an appropriate time limit was set for all questions, with the exception of the question that required an analysis of a Case Study. This feedback helped in setting time constraints for the Post-Test.

B. The Learner Centric Activity

The conduct of the formal sessions was carried out in two parts:

(i) Lectures to impart the theoretical knowledge and concepts

(ii) Sessions to build on the technical and practical skill set required to complement this knowledge base.

The group activity - which was used more for a formative assessment of the knowledge assimilated by the students rather than an evaluation mechanism for a grade - was conducted after the completion of the formal sessions. The activity focused on the analysis of a Case Study leading to the design of an Entity Relationship Diagram (which is an important sub competency in Conceptual Designing) for the application resulting from the Case.

a) The activity comprised of the following stages:

(i) The class of 30 students was divided into 5 groups (6 students in each group). Each group was homogenous in nature with respect to the pre-test performance and major learning styles.

(ii) The groups were given case studies for analysis and design. The complexity of the Case given to the group depended on the knowledge base and analytical ability of the group.

Two of the groups had the same case; the relatively weaker group had a different one. The Case Studies that were given to two groups were similar so as to draw out the fact that there can be diverse solutions to the same problem. The weaker group had no comparative Case Study as their confidence and morale should not shrink.

This is contradictory to what was done in the previous years, but was a plausible exercise as this activity did not entail marks allotment that contributed to the grades obtained in the semester. This group activity was mainly used as an active learning tool, and the experiment could progress without any prior permission.

The objectives of this group activity were made known to the class in advance.

(iii) Students were given two hours to deliberate on the case. The roles in the groups were unassigned, and the team members themselves took on the necessary responsibilities.

(iv) After the deliberations within the group, the learners had to make a presentation that illustrated and explained the Entity Relationship Diagram which evolved from the given Case Study. The activity in (iii) was observed, and it was noted that these deliberations brought in diverse opinions and solutions to aid in solving the problem. This helped the learners in improving their analytical skills and their skill to critically interpret and evaluate the work of their peers. It also enhanced their ability to collaboratively arrive at and abide by the groups' consensus – an important requisite for a team to work harmoniously. Group work being a very crucial and important activity involving multiple skill sets from many contributors, these skill sets and ideas need to be harmoniously integrated before the entire team proceeds to the next stage.

(v) The presentations were peer reviewed and were interspersed by questions and constructive criticism from the audience (learners and faculty). This proved to be very useful as the learners were made to note the pros and cons of a design choice in different application scenarios. The learners also enhanced their ability to synthesize and connect material to their existing knowledge base. This process of integrating information gave them a much deeper understanding of the subject.

(vi) The peers (i.e., the other groups) had to evaluate the group work and presentations on parameters that were assigned a priori, and subsequently rate the group on a scale of 1-4. The faculty also accessed this activity to verify the evaluation skills of the learners.

After the completion of the activity, the learners were given a comprehensive feedback form with questions organized into four important categories - the clarity of the objectives, the effectiveness of the activity, the relevance of the case and the amount of learning that took place (as an individual and as a member of a team).The answers were sorted looking for common themes that arose from the subjective questions; percentages of students were calculated for the categorical answers. A summary of the feedback is shown below:

Part A: Categorical Feedback

97% said this activity proved to be a better learning method and 90% were able to obtain a deeper understanding of the subject and the design issues and could thus evaluate their peers effectively;

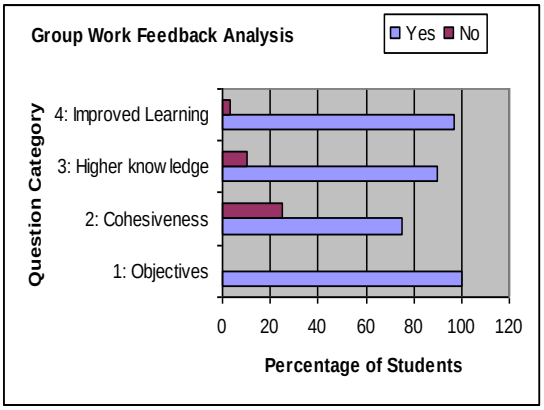


FIGURE 2: ACTIVITY FEEDBACK ANALYSIS

Part B: Non Categorical Feedback

(a) 71% of learners felt they had given an equal contribution to the group, while the remaining 29% mentioned that their contributions were at a high level; No team members contribution was considered negligible.

(b) 40% of learners mentioned that the Case study was at an advanced level. Majority of the students found that they were given an appropriate case study.

Part C: Qualitative Feedback

A subjective feedback can also substantiate the usefulness of an activity. All remarks on the feedback form were positive. Some of the statements made were:

"We learnt to be more creative and reflect on our own work"; "We learnt to think logically"; "We learnt what went wrong with our thinking"; "We could clear our confusions and doubts"; "Discussions help us to understand and analyze the problem much better"; "Better subject understanding through a very interesting way of learning"; "We grew from weak to effective"; "We learnt how to meet our deadlines without being stressed – it was fun".

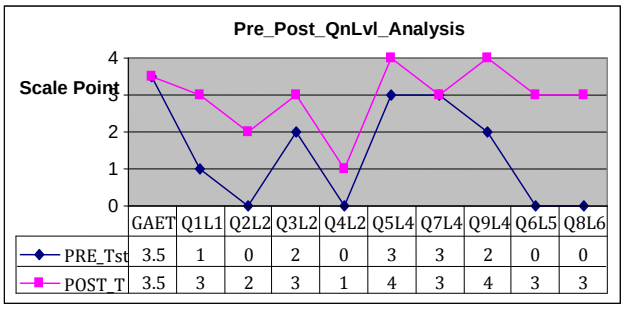
What clearly stood out was the fact that there was an active participation of every learner in the session and the feedback revealed that each of the learners, even those who normally do not participate in the class, said they had gained immensely from this stress-free interaction.

C. The Formative Assessment with Feedback

After the assessment, the faculty gave every learner an individualized feedback that sought to guide them towards achieving higher order skills. The sample feedback for one such individual is as shown below and is based on the performance scale levels obtained from the Pretest (The lower graph line in Figure 3)

Individual Pre-Test Feedback:

- Not much Comprehension of the material.
- High on Analytical Skills.
- Solving of Case Studies will help Application of knowledge.
- Discussions with peers/seniors/faculty will help Synthesis and Evaluation skills.



	GAET	Q1L1	Q2L2	Q3L2	Q4L2	Q5L4	Q7L4	Q9L4	Q6L5	Q8L6
PRE_Tst	3.5	1	0	2	0	3	3	2	0	0
POST_T	3.5	3	2	3	1	4	3	4	3	3

FIGURE 3: IMPACT OF FEEDBACK

D. The Post Test

The Post Test was divided into two sections. Part A of the test had the PreTest questions repeated. No definitive marks were alloted for each question, but a learner would get scale points (which would be translated into marks based on a formula) for the "amount of individual learning". Part B was a normal test with questions focussing on all levels of the Blooms Taxonomy range and was marked in the traditional way.

Figure 4 captures the individual amount of learning for this competency. This was used to allocate marks for Part A of the Post test.

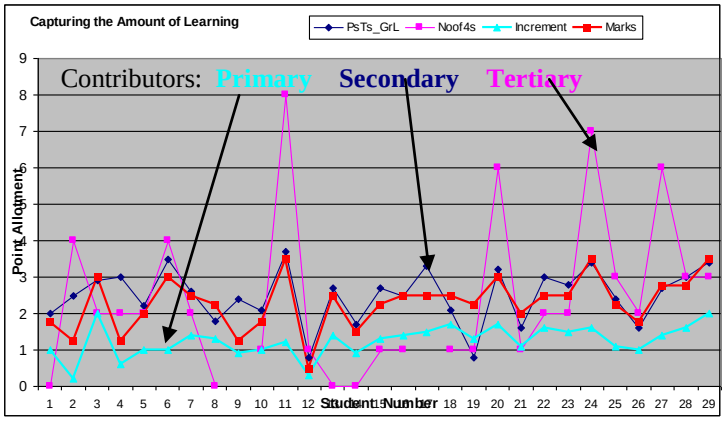


FIGURE 4: MARKS ALLOCATION FOR AMOUNT OF LEARNING

The red line in the graph (Figure 4) displays the corresponding marks obtained by the student in the Part A component of the Post Test.The marks awarded for the amount of learning were obtained by the formula:

$$0.60*A + 0.25*B + 0.15*C,$$ where,

A is the increment in the overall scale point obtained from Pre to Post test (primary contributor)

B is the Post Test Scale Point (secondary contributor)

C is the Number of questions that the student obtained the highest scale factor (tertiary contributor).

The impact of the individualized feedback to the students can be seen from the graph shown below (Q6, Q8 and Q9). There was a substantial improvement in the performance scale of the individual for these questions.

IV. ANALYZING THE PERFORMANCE

A. Analyzing the Question Paper

The Question Paper itself was organized as follows: Questions Q1, Q2, Q3 and Q4 were at the Level of Knowledge and Comprehension; Question Q5 was an Application Level Question; Questions Q7 and Q9 were targeted at the Analysis and Application

Levels; Questions Q6 had both an Analysis and Synthesis orientation; Question Q8 was a question that involved the highest skill set on Evaluation. Each of the above questions had subsections within them.

To validate the quality of the assessment, it is important to check the quality of the question paper itself. It was found that the class conformed to the recommended pattern of learning and followed the Gaussian distribution for their grades. Further, the discriminating question in the paper was the one that tested the highest level skill set. Figure 5 reveals the following:

(i) Question 8, which tested the evaluation skills of the learner, had the best discriminatory power. This can be seen from the graph where the StdDev for Q8 is the highest.

(ii) An important observation relevant to this study is the StdDev for Q7 - which is the lowest. This also substantiates the hypothesis that the kind of group activity performed helped to bring all learners to a similar standard (which is a substantially high grade scale of 3 - as seen from the bar chart in Figure6).

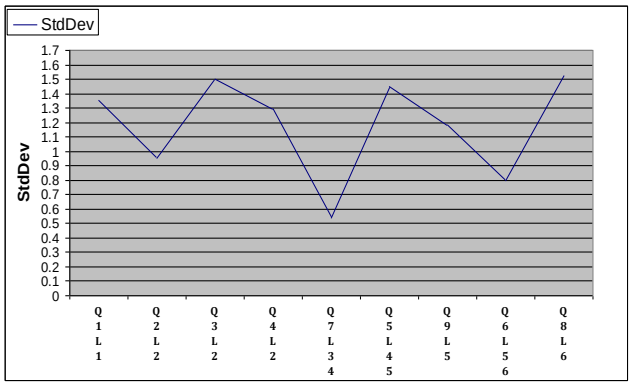
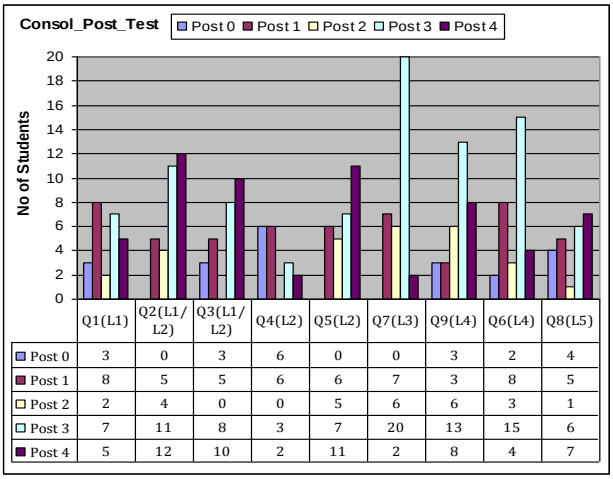


FIGURE 5: STDDEV FOR POST TEST QUESTIONS

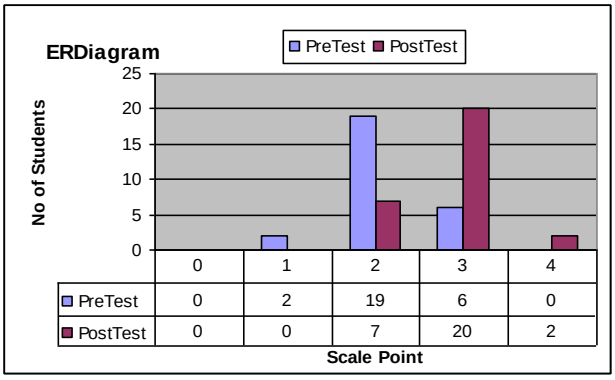
B. Analyzing the impact of the competency based activity

The assessment of the group activity conducted above was evaluated through Q7 and its impact can be seen from the Bar Chart shown in Figure 6. This chart displays the students' performance at the various question levels. The chart reveals that the maximum number of students scored a scale of 3 (Sufficient amount of knowledge with near optimal solutions) in Q7. It is worth noting that Q7 assessed the higher skill levels of the learner and a high score with a minimal stddev was achieved because of the group activity. Figure7 gives a more detailed report of the performance at Q7 by comparing the Pre and Post test scoring patterns. The figure reveals the following: The Pre-test shows that 2 students had a scale of 1, 19 students a scale of 2, 6 students achieved the higher scale of 3 and no student had a scale of 4; the rest not having attempted the question. The Post-Test reveals that 7 students obtained a score of 2, 20 students achieved a score of 3, and 2 students achieved the highest score of 4. What is important to note is that a maximum number of students had the required jump in the performance grade from 2 to 3, i.e., from a "level of confusion" to a "level of sufficient amount of knowledge".



	Q1(L1)	Q2(L1/L2)	Q3(L1/L2)	Q4(L2)	Q5(L2)	Q7(L3)	Q9(L4)	Q6(L4)	Q8(L5)
Post 0	3	0	3	6	0	0	3	2	4
Post 1	8	5	5	6	6	7	3	8	5
Post 2	2	4	0	0	5	6	6	3	1
Post 3	7	11	8	3	7	20	13	15	6
Post 4	5	12	10	2	11	2	8	4	7

FIGURE 6 : PERFORMANCE AT POST TEST



	0	1	2	3	4
PreTest	0	2	19	6	0
PostTest	0	0	7	20	2

FIGURE 7: PRE AND POST TEST COMPARISON FOR Q7

C. Analyzing the effect of the change in group composition

As mentioned earlier, the group composition was changed from a heterogeneous group mix to that of homogenous in the year 2009. The outcome of this change is observable and worth noting. The point of interest here is the increment in the amount of individual learning within a homogeneous group composition. There is no "free-loading" and every individual contributes to the group activity. Further, not wanting to show any weaknesses in comparison to other groups, the "lower achieving" groups work even harder, resulting in a better individual growth. Some other intrinsic benefits are greater confidence, a sense of achievement and subsequently, an increase in their motivation levels. The performance results of the individual learners with a change in group composition over the years from 2007 – 2009 reflect the above.

Table1 displays performance statistics of grades obtained by individuals at the examination conducted

at the end of the semester. The table displays the data relevant to this study, i.e., the grade points obtained at the Questions that assessed the "Conceptual DataBase Design (Entity Relationship Diagramming - ERD)" competency and the overall course grades. The end-semester examination is a traditional examination graded over a 9 point scale.

TABLE 1: INDIVIDUAL GRADE DATA AT END OF COURSE

YEAR	AVG_ERD GRADE	AVGDEV ERD	MODE ERD	AVG_OVRL GRADE	AVGDEV OVRL	MODE OVRL
2009	8.41	0.74	9	6.72	1.33	7
2008	7.31	1.30	7	6.07	1.73	8
2007	6.03	1.21	7	6.51	1.22	7

The group activity in the Year 2007 did not have much of an impact on the individual learning. This can be seen from the fact that the average grades, the AvgDev and the mode are almost equal for the overall course and the question on the ERD. In 2008, although the average ERD grade is higher than the average overall grade, the mode of the overall grade is one scale higher than the mode for the ERD grade. This is a reflection of the fact that although there was more consistency in the consolidated class learning for the Conceptual Design module, there was still a large variation in the amount of knowledge each individual learner had for the ERD concept. The year 2009 shows a drastic and positive change in the statistics. The average and mode of the ERD grades is significantly higher than their counterparts for the overall grade. The AvgDev for ERD grades is also significantly lower than the AvgDev for the overall grade. This validates the fact that the group learning activity increased the amount of learning for all the individuals by a significant amount; and reducing the variation in the knowledge level. This evaluation being an end semester examination also reflects the retention levels of the learners.

V CONCLUSION

A curriculum design framework based on competencies can help improve the quality of the learners. When the course was conducted in the earlier years, students were taught in the order formulated in the prescribed syllabus built on a prescribed textbook. This resulted in producing students with packages of knowledge, but not well defined and identifiable competencies.

Assessment efforts should not only determine whether students are acquiring the specified competencies but should enable students to visualize the desired level of performance and provide feedback for improvement. An ideal scenario would involve a mechanism for students to upgrade themselves in the competencies they failed to achieve.

The general perception has been that heterogeneous groups are necessary for effective Collaborative Learning with the essence being the achievement of the group, and not necessarily the impact on individual learning. Although tentative, this study suggests that 'homogeneity' can substantially improve the amount of learning for the individual. The retention span also remains significantly longer for all learners in this learner centric activity.

More research needs to be done in this area. The next phase will be an automated group formation through knowledge discovery of students' learning styles at the time of admission. Activities can then be suggested to improve learning effectiveness for these groups leading to a more productive learning environment. The final aim would be to maximize the possibility of student success in an enjoyable learning environment.

REFERENCES

[1] BARKER L.J., 2005, When do group projects widen the student experience gap? In Proceedings of the 10th Annual SIGCSE Conference on Innovation and Technology in Computer Science Education (ITiCSE'05), 276–280.

[2] BOWER M., RICHARDS D.,2006, Collaborative learning: Some possibilities and limitations for students and teachers. In Proceedings of the Conference for the Australasian Society for Computers in Learning in Tertiary Education (ASCILITE'06), 79–89.ACM Transactions on Computing Education, Vol. 9, No. 1, Article.

[3] BRADSHAW S.D., STASSON M.F.,1995, Explanations of individual-group performance differences: What sort of "bonus" can be gained through group interaction? Small Group Research, 26(2), 296–308.

[4] CRAGAN J., WRIGHT D.,1995, Communication in small groups: Theory, process, skills (4th ed.). Minneapolis/St.Paul, MN: West.

[5] GAFNEY L., VARMA_NELSON P., 2007, Evaluating Peer-Led Team Learning: A study of long-term effects on former workshop peer leaders, Journal of Chemical Education, 84, 3, March 2007, 535-539.

[6] LEJK E., 2008, Management of cultural diversity in group assessment for learning Centre for Excellence in Teaching & Learning Assessment for Learning, CETL AfL, University of Northumbria. Nov 24, 2008, http://northumbria.ac.uk/static/5007/cetlpdf/emmaleyk

[7] MUEHLENBROCK M., 2006, Learning group formation based on learner profile and context. Int. J.e-learning IJEL 5(1), 19–24, 2006.

[8] NICOLAY J. A., 2002, Group assessment in the online learning environment. New Directives in Teaching and Learning , 91, 43–53.

[9] PAREDES M.E., 2004, Using learning styles for dynamic group formation in adaptive collaborative hypermedia systems. In Proceedings of the First International Workshop on Adaptive Hypermedia and Collaborative Web-based Systems, AHCW 2004,188-

198 available at http://www.ii.uam.es/~rcarro/AHCW04/MartinParedes.pdf
[10] PINTO Y., 2008, A Framework for Competency Based Curriculum Design, IATED, ICERI Nov 17th-19th 2008, Madrid, Spain, ISBN: 978-84-612-5091-2.
[11] SCHROTH G., PANKAKE A., GATES G., 1999, A Comparison of Pedagogical Approaches to Teaching Graduate Students in Educational Administration, Journal of Instructional Psychology, Dec, 1999.
[12] SHAW M.E., 1976, Group dynamics: The psychology of small group behavior (3rd ed.). New York: McGraw-Hill.
[13] WEBB N.M., NEMER K.M., CHIZHIK A.W., SUGRUE B., 1998, Equity issues in collaborative group assessment: Group composition and performance. Amer. Edu. Resear. J. 35, 4,607–665.