Integrating Teaching and Research to ensure the progression path of students from Research Led to Research Tutored Approach

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Abstract: In most of the universities or institutes of the world, teaching and research are being carried out in isolated zones without any integration. This restricts the exponential growth of technical know-how not only of the students but also of the teachers, and defeats the total purpose of our education system. So, the concept of integrating research and teaching is very important in the sense that it will open up a new horizon of possibilities. This intervention was implemented in a first year PG course. The students were informed about the research and design problems during the lecture classes. During the progression of the courses, 'Course Instructor feedback', 'Student Feedback' were collected. The students' performance in the course was also monitored. The collected information suggests that students really enjoyed their learning experience in the abovesaid subjects. Moreover, 33.33% of the students worked in the same field for their dissertation work.

Keywords: Research led teaching. Research tutored teaching. Research teaching links

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1. Introduction

In most of the universities or institutes of the world, teaching and research are being carried out in isolated zones without any integration, as shown in Figure-1. This restricts the exponential growth of technical know-how not only of the students but also of the teachers, and defeats the total purpose of our education system which aims at providing active learning environment to the students. In a way, this will never introduce our students to active creation, discovery and validation of knowledge. So, the concept of integrating research and teaching is very important in the sense that it will open up a new horizon of possibilities not only for the students but also for their teachers, their institutes or universities, and society as a whole.

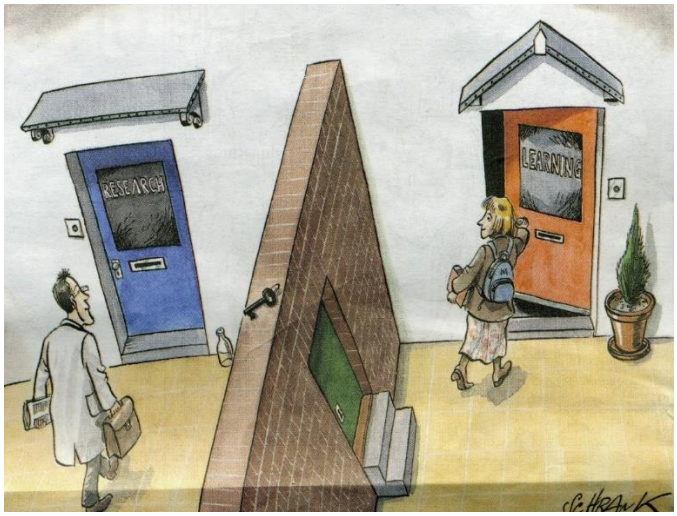

Figure-1: Teaching and Research in Isolation

2. Literature Survey

Research integrated teaching refers to the whole package of learning in terms of disciplinary concepts, theory and application has to be carefully designed to fit in the research expertise into the students' learning experience and meeting the course learning outcomes. As per Brew (2006), research and inquiry engage undergraduates meaningfully in higher education and prepares them for a twenty-first-century world of work where knowing how to inquire and critically evaluate knowledge is of increasing importance. Trowler and Wareham in 2008 stated that *Research Integrated Teaching* reflects and makes use of the teacher's disciplinary research to benefit student learning and outcomes. There are various factors to integrating research and teaching which are listed below:

- ✓ Definition of research in the institution
- ✓ Academic choice in teaching
    - Teaching research interests
- ✓ Student awareness of research
- ✓ Students researching with peers vs students engaging with communities of scholars and scholarly activity
- ✓ Funding matters
    - Division of funding between teaching and research
- ✓ Institutional factors
    - Promotion, performance criteria
- ✓ Assumptions about teaching
    - Modularity
    - Pedagogy
    - Space
- ✓ Teaching vs Research academics

The various models of integrating teaching and research have been reported in literature. Out of these, an attempt has been made here to briefly present the block diagrams of these models in Figure-2 (Boyer, 1990), Figure-3 (Brew, 2003), Figure-4 (CoP Model) and Figure-5 (Fung, 2017). Based on these models, one can easily identify the following research-teaching links (Healy, 2005):

1. Emphasizes research content or Research processes and problems
2. Students are treated as audience or participants
3. Teaching is Teacher-focused or Student-focused

The Healy's model about various research teaching links is shown in Figure-6. It defines that there are four main ways of engaging undergraduates with research and inquiry:

- Research-led:
  learning about current research in the discipline;
- Research-oriented:
  developing research skills and techniques;
- Research-based:
  undertaking research and inquiry;
- Research-tutored:
  engaging in research discussions.

Figure-2: Boyer – Redefining Scholarship

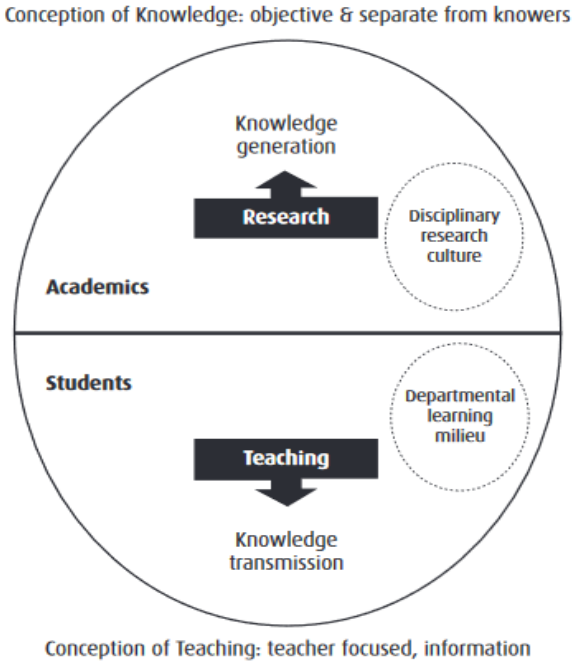

Figure-3: Brew Model depicting relation between Teaching and Research

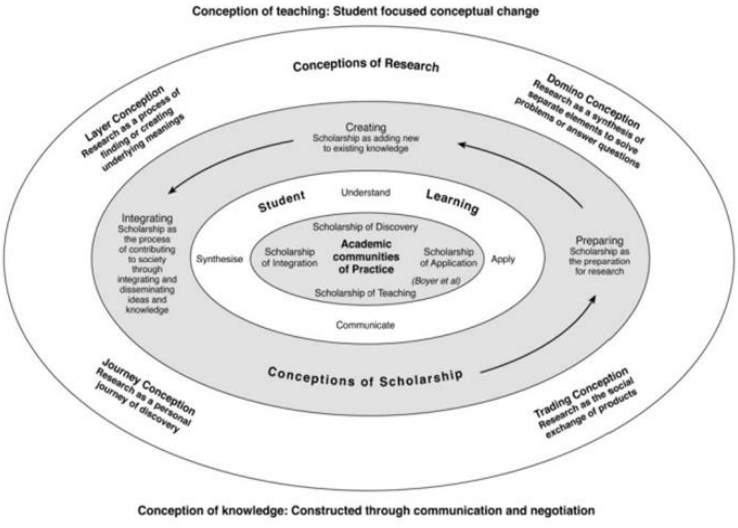

Figure-4: CoP Model

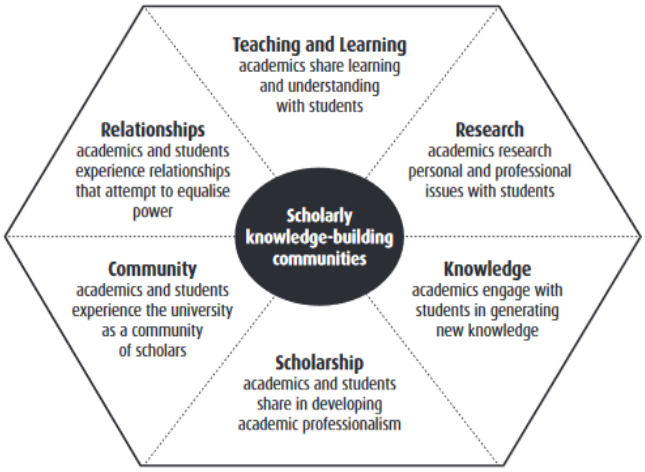

Figure-5: Fung Model depicting relation between Teaching and Research

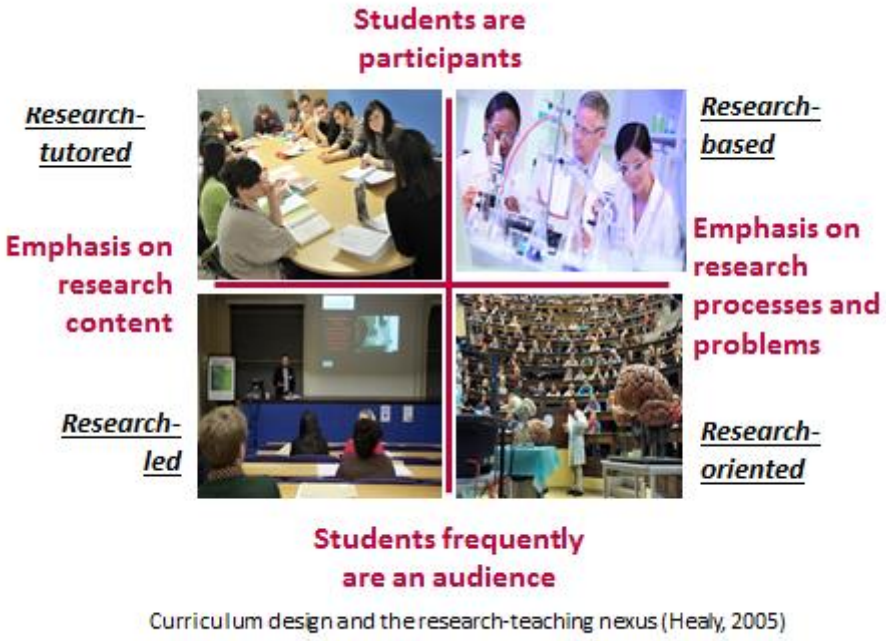

Figure-6: Healy's Research-Teaching Nexus

3. The Intervention

The students need to tell what they need to know. They also need to be engaged in 'How to Learn?' Finally, they need to be encouraged to seek and discover new things (Hodge *et. al.* 2007). This will definitely make them in being a better person wherever they serve which will ultimately help in making our nation great. The following are the benefits of research integrated teaching (Teaching Research Nexus 2009) from the Learner's point of view:

- ✓ Deeper understanding of the knowledge bases of the disciplines and professions, including research methods and challenges.

- ✓ Development of intellectual capabilities, enhancement of their skills for employment, and zeal for lifelong learning.

- ✓ Experience of independent research and inquiry.

Enhanced engagement in their studies and application in the real world. After having a fair idea about the research integrating teaching, it is also important to understand the students' learning journey which has the following stages:

Paradigm	Approach
Teaching	Telling students what they need to know
Learning	Engaging students in learning how to learn; emphasis on learning what they need to know
Discovery	Encouraging students to seek and discover new knowledge
Creation	Encouraging students to apply their knowledge to create something novel

The real trajectory path of students' advancement and/or maturity is presented in Figure-7, where the role of teacher as a facilitator is very important. The teacher must ensure that the students who have initiated his/her journey in research-led teaching must progress to research based or research tutored teaching.

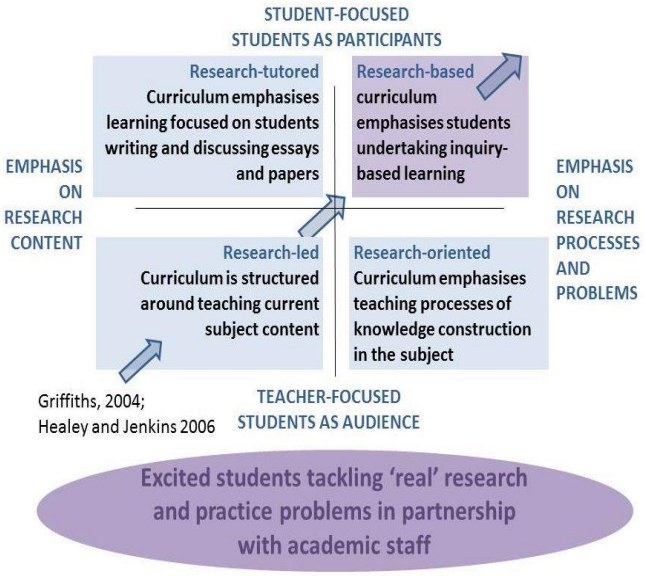

Figure-7: Real Trajectory Path in Healy's Model

I also decided to take this intervention in a first year course entitled 'Power System Transients and Mitigation'. This is part of the M.E. Power Systems Programme. There were 15 students in the class in July-Dec., 2016. I felt from the discussions with the batch of students who passed out in 2015 were not comfortable in the 'Power Quality and Custom Power' topic (Hingorani 1995; Stones & Collinson 2001; Bollen 2003; Mishra, Ghosh & Joshi 2003; Crow 2004) as very limited content is available in the text books. For this, in addition to applying my technical know-how or research experience (Hounsell 2002; Griffiths, 2004; Healey 2005; Healey & Jenkins 2007; Trowler & Wareham 2008), I had to consult my Ph.D. thesis supervisor who is an active researcher in this field. My Ph.D. field of work is also related to the same area (Nijhawan, Bhatia & Jain 2013). For this, a suitable course module needed to be designed to help the students understand about the need and benefit(s) of this problem. This was actually a challenge because not much has been covered in the prescribed text books. So, the research papers addressing this problem were consulted. So, international power quality standards

(IEEE 519-1992, IEEE Std. 1366-2000, IEC 61000-2-1, IEC 61000-4-7 and IEC 61000-3-6) were consulted for this. To ensure proper learning, the number of problems and case studies were taken up in the class. Also, the students were given sufficient number of research papers to explore in addition to the tutorial sheets (Brew 2006). The students were well exposed to the scope of research in this field and advised to carry out group activity in a group of 2-3 (Benson & Blackman 2003) for improving their insight into the subject.

The suitable course module was designed. I tried my level best to ensure its proper delivery in the class for the benefit of the students. To ensure that the students are satisfied with the course delivery method and contents, a 'Course Instructor Feedback Form' was designed. Each student in a class was asked to fill this form. This form is appended with this assignment. Then, another survey form 'Student Feedback Form' was designed to assess the comfort level of the class in this topic. This form is appended with this assignment. The students were to rate each of the points in the above-mentioned forms on the scale of 1 (strongly disagree) to 5 (strongly agree). To check the actual understanding level of the class, the whole class was divided into seven groups, and advised to carry out group activity in a group of 2-3 (Benson & Blackman 2003; Brew 2006; Hanney 2013).

I evaluated this approach in three stages during the running semester, one SRS conducted by the Institute at central level (Annexure-A) and one post course assessment/analysis. So, a total five stage verification and analysis led me to develop a fresh insight into the assessment of my research integrated teaching approach followed in this class.

Course Instructor Feedback:
Before going in for the assessment of the students (Indirect and Direct), I decided to take the feedback from the class answering the following questions:

1. This topic is informative and helpful in developing your technical know-how.
2. The course instructor referred some international standard(s) related to this topic.

   Kindly, mention the name of this/these standard(s).

3. The information given by the course instructor will be useful to you in the field job.

4. The course instructor made you feel free to ask questions in the class.
5. The course instructor communicates effectively in the class.
6. The course instructor shared his research experience related to this topic.
7. The course instructor shared some additional knowledge with the students besides the content given in international standard(s) related to this topic.
8. The course instructor explained the objective(s) of this problem/topic.
9. The course instructor helps the students to solve some design problem(s) in class.
10. The course instructor includes some real life problems related to custom power in the tutorial sheet(s)/assignment(s) of the course.
11. The course instructor allows you to be active in the classroom learning.

12. The course instructor listens and understands student's point of view. He may not agree but students feel understood.

Average Weighted Score of 4.8 on a scale of 5 for the Course Instructor Delivery in the class was obtained.

STUDENT SURVEY FORM: Indirect Measurement

After this, an indirect measurement of student's understanding about the topic was carried out. For this, the feedback from the class was taken by answering the following questions:

After going through the classes of the above-mentioned topic:

1) I know the objective(s) of the custom power.
2) I have the knowledge of the terminologies related to the power quality and custom power.
3) I have the ability to analyse and propose a suitable custom power device for mitigation of various power quality problems in a distribution network.

Average Weighted Score of 4.53 on a scale of 5 for Indirect Measurement was obtained.

STUDENT EVALUATION: Direct Measurement

The whole class was divided into seven groups, and were given independent design problems. They were given ten days' time to complete and submit their assignments.

Self Assessment:

From the two surveys that were carried out, it is clear that the students were pretty happy and satisfied with the contents, and the manner in which the whole of the topic was covered in the class. The comfort level of the students in this topic when measured through direct and indirect methods was also very encouraging. Students had really done very well in their assignments which at the end is very satisfying for me. ***Average Weighted Score of 4.58 on a scale of 5 for Direct Measurement was obtained.***

Post Course Assessment:

Whatever feedback and assessment results presented so far was during the time when this course was being run in their first semester (July-Dec., 2016). So, the task was not over yet as the progression path of the students towards 'Research based' and 'Research tutored' teaching from 'Research led' teaching was not ensured. For this, I used to interact with this class even after their first semester when I was not taking their course to keep them actively involved in the whole learning process. I along with Dr. S.K. Jain organized an IEEE India International Conference on Power Electronics (IICPE-2016) in November 2016, and involved these students in the organizing committees of the conference to arouse their interest towards research.

Out of total of 15 students of this class, 5 students opted to work for their M.E. dissertation work in the field of 'Power Quality and Custom Power' under different supervisors in July 2017. One student (Mr. Sourav) was also working under my supervision. Out of these five students, two students secured 'A' grade, two students secured 'A⁻' grade and one student secured 'C' grade in their M.E. dissertation work in August 2018 at the time of passing out from the institute. My student got acceptance of his two research papers in SCIE journal (Indian Journal of Geo-Marine Sciences), and secured 'A' grade in his M.E. dissertation. The acceptance letters of his research papers have been included in Annexure-E. One of the other students (Mr. Sahil Mehta) got his one paper published in a peer-reviewed journal, and also got admission for the Ph.D. programme in Thapar Institute of Engineering and Technology. He is

extending his M.E. dissertation work for his Ph.D. research. In light of all these developments, I can safely conclude that I was pretty successful up to some extent in implementing 'Research Integrated Teaching' model in my M.E. Power Systems class which will definitely lead to many more success stories of my students.

5. Summary and Conclusions

This paper has examined the impact of Integrating teaching and research to ensure the progression path of students from Research Led to Research Tutored Approach, for establishing an active learning environment. This approach is not only beneficial for the students but also for university's or institute's branding, and for the better and sustainable society. From the surveys conducted and the performance evaluation of the class, it is clear that the class seems to have understood this topic very well. This is really very satisfying for me as a facilitator. Even in the formal and informal discussions with the class, the students seem to be satisfied which means a lot to me. This is the highest or the greatest award or prize that a teacher as a facilitator can get. Therefore, it can be safely concluded that one should consider students as partners in the whole teaching learning process where they should be encouraged to explore the world through independent research and inquiry.

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