

Undergraduate students' research: A case study of their experiences and perceptions in an Autonomous Institution

Dr. Srinivasa Pai P *
Professor

Dr. Niranjana N. Chiplunkar
Principal

Dr. Shrinivasa Rao B R.
Vice Principal & COE

Dr. K. Subrahmanya Bhat
Professor & Head

Dept. of Mechanical Engg., NMAM Institute of Technology, Nitte-574 110. Karnataka

*Corresponding author Email: srinivasapai@nitte.edu.in

Abstract

Undergraduate students are the important element of any University / Institution involved in higher education and research. They influence the education system and their involvement, experience and satisfaction determines the success or failure of any Institution. Research is an integral component of the teaching-learning process and it has been found that academic excellence depends on research excellence. In this context, there is a need to involve undergraduate students in the research activities in different disciplines, in order to train them to understand the nuances of research. In fact the involvement of undergraduate students in faculty research activities is very minimal and they are denied the benefits of a research-based learning experience. This paper tries to present the current status of involvement of undergraduate students in research activities in two departments in an autonomous Institution. It discusses the students' awareness, experiences and perceptions and suggests measures that can be taken to increase their involvement in research.

I. INTRODUCTION

Higher education is undergoing a paradigm shift, from a teacher-centered teaching-learning activity to a learner-centered activity. This change is clearly felt in all streams of education and more so in engineering education. Students learn more when they involve themselves in the subject may be through practical sessions or hands on experience in the laboratory, rather than only from teaching in the class room.

Research is an integral part of the higher education structure, which can be defined as an intellectually controlled investigation that leads to advances in knowledge through discovery and codification of new information or the development of further understanding about existing information and practice (Patrick and Willis, 1998 cited in [1]). According to Patrick and Willis (1998), "teaching is a multidimensional activity that seeks to promote quality

learning through a student-centered interaction between teacher, student and curriculum" [1]. Research and teaching are activities which are associated with teacher and student and are essential functions of any higher educational Institution and support each other.

In the Indian context, leading technical Institutions in the country like IITs and NITs are able to produce lot of intellectual output in terms of publications in leading journals, conferences, patents, models, prototypes etc., because of a substantial contribution by UG students. There is a need to replicate this in all the Institutions in the country and autonomous Institutions have lot of flexibility in this regard, as they frame their own curriculum and can provide the students a better 'research-based' learning experience. In this regard, this paper tries to present the current status of UG students' involvement in research activities of two departments in an autonomous Institution. The student's awareness, perceptions and experiences about the current status has been analyzed through a customized questionnaire, based on a standard questionnaire developed by University of Gloucestershire, UK [2]. Based on the findings, measures have been suggested to involve more UG students in the research activities, so that students are not denied the positive experiences of their involvement in research and help them to grow intellectually and increase the output in terms of publications, models, prototypes and patents and contribute to knowledge generation and dissemination.

II. PERSPECTIVE FROM LITERATURE

Considerable literature is available regarding the involvement of undergraduate students in the research activities of their faculty, department and University. Trying to review all of them is not possible. A few of the important literature related to this have been reviewed here in order to provide a perspective.

Jusoh & Abidin (2012) presented a study of students' awareness, perceptions and experiences on teaching-research nexus in three Universities in Malaysia. The findings were based on a questionnaire circulated among 480 students in which students were moderately aware of the research activities of their lecturers. The findings of this study supported curriculum development that encouraged undergraduates to be exposed widely to their participation in the research of their departments. The study felt the need to create awareness among undergraduate students' about research activities and encourage them to participate as part of the academic community [1].

Ozay (2013) presented a case study of undergraduate students' awareness, perceptions and experiences of research in a major metropolitan university in Australia. The findings were based on the responses to a questionnaire in which 282 undergraduate students from humanities-based disciplines participated. Though majority of the students were in their first year, they were aware of the different types of research going on around them and obtained some form of research experience during their studies. More than half the participants felt that they learn the best, when they are actively engaged in research processes [3].

Short et al. (2010) in a report compared the findings of two surveys undertaken in 2002 and 2009 regarding awareness, perceptions and experiences of final year undergraduate students at University of Gloucestershire, UK. It was found that there has been an increased awareness among students about research in the seven year period. There were both positive and negative impacts that staff research had on their learning, but the positive impact was almost four times more than the negative impact [4].

Hajdarpasic et al.(2011) summarized the key findings of a survey about undergraduate awareness, experience and perception of research undertaken at Macquarie University. It involved a random sample of 200 UG students taking a face-to-face survey designed to gather both qualitative and quantitative data. Some of the major findings included – students were generally aware of research and had experienced research in a range of ways, involvement of staff in research was perceived to be beneficial. Many felt that it motivated them to pursue post graduate studies and benefited their professional skills and employability. Some negative observations included their awareness and experience of research was limited, many did not develop any research skills and many felt that staff's involvement in research affected their learning in terms of no time for staff for interaction and curriculum loaded with the staff's research interests [5].

Myatt P., (2009) investigated undergraduate research experiences as one mechanism to enhance teaching-research nexus. This study looked at not only the benefits perceived by the students, but also at the development of learning, skills and attitudes, which are intangible. The study looked at the benefits the students gained and how were these benefits when compared to those reported early and to what extent involvement by UG students in research impacted their future career decisions [6].

Healey and Jenkins (2009) in their work argue that all UG students in higher education Institutions should experience learning through research and enquiry. They argue for the need of a research-active curriculum. Through a number of case studies, they revealed interesting and effective practices from the level of the individual courses to national policies [7].

This short review of literature clearly highlights the need for providing undergraduate students a research based curriculum, which can help them to gain experiential learning and help them with their placements and future career option selection. There is a need to conduct similar studies in the Indian context, to understand the various issues with regard to this and work out ways and means to strengthen the teaching-research nexus.

III. CURRENT STATUS OF INVOLVEMENT OF UG STUDENTS IN RESEARCH ACTIVITIES AT NMAMIT, NITTE.

NMAM Institute of Technology, Nitte is an autonomous Institution under Visvesvaraya Technological University (VTU), Belgaum in India. The significance of research has been well understood by the Institution, with a consistent increase in the number of faculty obtaining PhD degrees and pursuing the same in the last few years. There has been a steady increase in the funded research projects, being executed by different departments. There has also been an increase in the intellectual output in terms of publications in refereed international and national journals and conferences, patents, technical reports, theses etc. Most of the research projects being executed and R & D initiatives taken up are by the postgraduate and PhD students. There have been some limited efforts in involving UG students in research activities in some departments. This section presents the current status of the same in two departments, which are active in research.

A. Mechanical Engineering department

This department has been active in the research front in the last several years. There are many faculty working on sponsored research projects with funding from agencies like VTU, Belgaum, DST, New Delhi and AICTE, New Delhi. To further the research activities and involve undergraduate student into research of the department and also to involve them into different emerging streams of mechanical engineering, many initiatives have been taken and three important ones are given below. Students actively involve themselves in these research activities, other than their regular academic schedule.

- *SAE-BAJA competition* - This is a competition organized by the Society of Automotive Engineers (SAE) every year and the students of the department have been actively participating since last year. There are two phases in this competition – first phase is virtual BAJA, where students show case

their design of the proposed car. The design is done using SOLIDWORKS and analysis using ANSYS. The second phase is the final evaluation of the designed and fabricated vehicle. Last year the team from the department participated in the event and won 38th position out of 125 colleges that participated in the competition at the national level. This initiative has been fully funded by the Institution.

- **ROBOTICS lab** – This lab has been started with an intention for the benefit of undergraduate students to work on mini projects on robotics, create their own self designed robots, to gain the practical knowledge related to the orientation of the end effectors, the circuits related to the required applications, creating customized circuits etc. Four basic robots were fabricated last year namely Line following robot, obstacle detection robot, All-terrain vehicle and a Quad rotor. The circuits were designed and the operation was controlled with the Arduino board. Presently a group of 40 students are working in this lab.
- **STUDSAT project** - It consists of two satellites, STUDSAT-2A and STUDSAT-2B. The project is being developed by STUDSAT-2 Consortium which is formed by seven Engineering colleges (including NMAMIT,Nitte) and VTU, Belgaum. The project executed at NMAMIT is involved in designing the mechanical structure. Students are involved in designing and analyzing the satellite structure to make it outer-space environment friendly and overcome the various obstacles to be faced during launch and also during operating conditions. More than 10 students were involved in this project during 2012-13 and 2013-14.

B. Biotechnology department

This department has the highest funded research projects from different funding agencies including DBT, New Delhi and BRNS, Mumbai. The department encourages undergraduate students to take part in research projects after they complete their IV semester, usually during the summer vacations. Students in a group of three or four are given a research topic and are given a week's time to do literature survey. Once the students are clear with the concept of the research work that they are supposed to carry out, they will be provided with protocol that they are supposed to follow. Some example projects include - Bioethanol production from cashew apple pulp and coffee pulp waste, Biodegradation of Municipal waste and Study on Caffeine degradation by Fungi.

The department has been successfully carrying on with this initiative since 2009, with success and has published research findings in leading international and national journals in the area of biotechnology. This has provided a platform for students not only to learn about 'research

methodology, collection of data, analysis and making publications. The students get an opportunity to use high-end equipments like HPLC, Atomic absorption spectrophotometer, Gel-doc system, horizontal and vertical electrophoresis. It has been found that those students who are seriously involved in the undergraduate research programme, which went on up to final year were successful in getting jobs in core companies because of research publications and many got admissions for doing their higher studies in leading Universities in India and abroad.

IV. ANALYSIS OF FINDINGS FROM THE SURVEY

To understand the research-teaching nexus and to know about the awareness, experiences and perceptions of undergraduate students about research in the Institution, a questionnaire survey was carried out among the students of mechanical and biotechnology engineering department with a few from other departments. The questionnaire is a modified version of a standard questionnaire prepared by the University of Gloucestershire [2]. The questionnaire is included in **Appendix**. The survey was focused on students who are currently active in research in their respective departments, as the focus of this survey was about their awareness and experiences about research and how the findings from this survey can be used to strengthen the nexus and increase the involvement of UG students in research. 26 students responded to the survey, with an average age of 20 years. In the questionnaire, a few students have not answered some questions, which can be attributed to their not understanding the question, non-awareness of the issue or a deliberate attempt not to answer the question.

The findings have been analyzed under – general awareness about research in the Institution, students' experiences about research in the Institution, types of research faculty are engaged in the department, the different ways in which research activities in the department has helped their learning and their awareness, perceptions and experiences about research. Fig. 1 shows the students' experiences about various aspects of research(1 – hearing a faculty discuss his/her research work, 2 – hearing an expert discussing their research work, 3 – reading a research paper written by a faculty member, 4 – attending a seminar / conference / workshop organized by the department, 5 – being a part of research conducted by a faculty member, 6 – development of research techniques, 7 – undertaking an independent project as part of the research of a faculty, 8 – helping the department by working as a research assistant, 9 – writing a technical paper to a journal or conference based on research work and 10 – contributing to research output in the form of a patent or any other form).

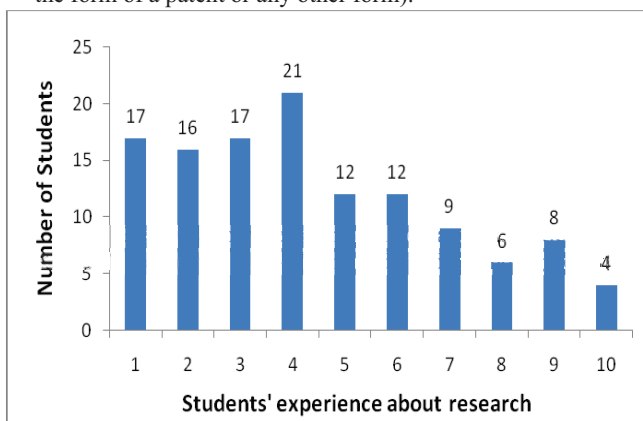


Fig. 1 Students' experiences about research in the Institution

subject, 2 – contributed to development of research skills, 3 – increased awareness about research methodology, 3 – stimulating interest in the subject, 4 – motivation to pursue PG/PhD research in the same area, 5 – motivation for a career in research, 6 – motivation to pursue a career in a particular kind of consultancy and 7 – motivation to pursue a career with a particular kind of consultancy).

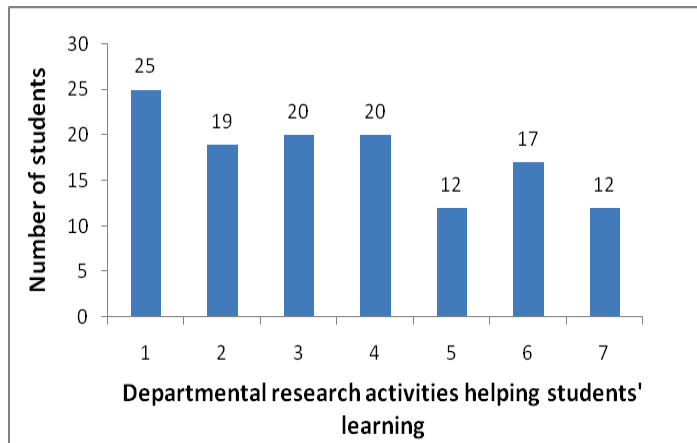


Fig. 2 Departmental research activities helping students' learning

The results of other findings have not been presented here due to limitations of length of the paper.

V. DISCUSSION AND SUGGESTIONS

The findings of this survey with a sample size of 26, may not represent the entire UG population of the Institution. However some interesting findings have been made with regard to UG students' awareness, perceptions and experiences of research, which are as follows –

- Around 73 % of the students were aware about the happenings in the institution about research.
- More than 60 % of the students have gained some experience about research in terms of hearing faculty discuss their research findings, experts, reading a research paper by their faculty and attending seminar/workshop/conferences organized by the department.
- The involvement of students in actual research of a faculty, development of research skills, taking up projects related to faculty research, working as a research assistant in the department, writing technical papers and contributing to research output is less than 50 %.
- It was found that about 30 % of the students felt that 61- 80 % of the faculty are engaged in research in their subject areas of interest.

- 73 % of the students were aware about their faculty undertaking a research degree like Masters or PhD and working on funded research projects.
- 54 % of the students were aware that their faculty are writing research papers to journals and conferences and are supervising research scholars. 46 % of the students were aware that their faculty are writing text books and working towards filing patents based on their research work.
- More than 65 % of the students felt that their involvement in research activities in the department has helped their learning in one way or the other. About 46 % of the students were motivated to pursue PG/PhD research in the same area, in which they were currently working.
- With regard to general awareness about research activities in their discipline of engineering, their perceptions and experiences, most of the students strongly agree about their involvement and faculty involvement in research and supported this involvement of UG students in research.
- Most of the students suggested the need for proper encouragement, support, guidance and help from the department to undertake research. The institution should provide necessary infrastructure in terms of labs, instrumentation, equipments and funding. Students need to be trained in research methodology, writing technical papers and reports and training about filing patents and related aspects.

Suggestions

Care should be taken while generalizing the findings from a study like this, as the sample size is small. Nevertheless, the findings do provide a clear picture about the awareness, experiences and perceptions of research held by 26 students from two departments active in research in the institution. There is an active interest among the UG students towards research, which needs to be strengthened. Students are able to identify benefits that they feel due to their and faculty involvement in research. The students are able to get up-to-date knowledge from their faculty, which not only increase their understanding of the subject, but also help them in their own research.

There is a need for the Institution to evolve a „research-based' curriculum, which will emphasize the research component in different courses taught depending upon the requirements. Students should be actively involved in the research projects of the faculty in the department, for which necessary schemes can be formulated like research assistantships, with or without stipend. They should be encouraged and properly guided to take up research oriented projects with suitable financial support. The Institution can take initiatives to start individual department level research labs, with common facilities and infrastructure, where

students can come and work. They need to be trained in research methodology, tools and techniques, technical paper/report writing and awareness about patents. This can be done through awareness workshops, value added courses or electives in the curriculum to provide them some direction regarding conduct of research.

VI. CONCLUSION

This paper presents a case study of UG students' awareness, perceptions and experiences about research in NMAMIT, Nitte an autonomous institution. The findings are encouraging with about 73 % of the students being aware of happenings related to research in the institution. Students felt their learning improved, they were motivated to pursue further research and helped them in their job placements. Some general suggestions have been made regarding the need to evolve a 'research-based' curriculum, which will strengthen the teaching-research nexus and help in increasing the intellectual output from the Institution and thereby contribute to knowledge generation and dissemination.

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APPENDIX

Students' awareness, experiences and perceptions about research at NMAM Institute of Technology, Nitte

(based on the questionnaire developed at University of Gloucestershire, UK in 2002 by Mick Healey, Fiona Jordan and Chris Short)

Section 1: Personal information

1. What is your discipline of engineering:
2. Male / Female (tick one)
3. What is your age?

Section 2: Your experience of research and consultancy

2.1 Are you aware of any of the following happening in the Institution? (Put a tick mark in front of all those which apply)

i.	Seminars / Conferences / workshops happening in different research areas	
ii.	Notice boards advertising research opportunities.	
iii.	Postgraduate courses offered / opportunities for students for projects/ research in the Institution and outside.	
iv.	Existence of research facilities in the department.	
v.	Departments in the Institution which have national / international reputation with regard to research / consultancy.	
vi.	Research outputs produced in terms of publications, journal articles, books, reports, patents filed etc., by different faculty members.	

2.2 During your studies in the Institution, have you gained experience in any of the following? (Put a tick mark in front of all those which apply)

i.	Hearing a faculty discuss his / her research/consultancy work.	
ii.	Hearing an expert / guest faculty discussing their research/consultancy work.	
iii.	Reading a research/consultancy paper or report written by a faculty member.	
iv.	Attending any seminar/ conference/workshop organized by the department.	

v.	Being a part of research / consultancy project conducted by a faculty member.	
vi.	Development of research/consultancy techniques (like interviewing, Lab. analysis, performance skills, design skills, statistical analysis, field work, literature review etc.)	
vii.	Undertaking an independent project as a part of the research / consultancy work of a faculty member.	
ix.	Helping the department by working as a Research assistant	
xi.	Writing a technical paper to a journal / conference proceedings based on research work.	
xiii.	Contributing to research / consultancy output in the form of a patent or any other form of output.	

2.3 Out of the faculty in your subject area(s) of interest, approximately what proportion are you aware are engaged in research? (Put a tick mark for one of the options)

None 1-20% 21-40% 41-60% 61-80% 81-100

2.4 Which of the following types of research work are you aware that your faculty is engaged in? (Write a yes in front of all those which apply) and if yes, write in what way you are involved.

i.	Undertaking a research degree (Masters / PhD)	
ii.	Undertaking non-funded personal research	
iii.	Undertaking funded research and/or consultancy	
iv.	Writing research papers for journals / conferences or seminars	
v.	Writing text books	
vi.	Working towards filing / obtaining patent based on research / consultancy work	
vii.	Supervising research students (Masters / PhD)	

2.5 If you have involved yourself in research activities in your department, in which of the following ways it has

helped your learning? (Please put a tick in front of all those which apply)

i.	Increased my understanding of the subject.	
ii.	Contributed to the development of my research related skills.	
iii.	Increased my awareness about methodology involved in conducting proper research work.	
iv.	Stimulated my interest and enthusiasm for the subject.	
v.	Motivated me to pursue my PG / PhD research in the same area.	
vi.	Motivated me to consider pursuing my career in research.	
viii.	Motivated me to consider pursuing a career with a particular kind of consultancy organization or body.	

2.6 From your experience to what extent do you agree with the following statements? (Give rating on a scale of 1 to 5, where 1 means strongly disagree, 2 means disagree, 3 means neutral, 4 means agree and 5 means strongly agree)

i.	I have increased awareness of research activities in my discipline of engineering.	
ii.	I was aware of the research/consultancy reputation of the faculty in my subject area(s), when I applied for study here.	
iii.	I am not aware of the benefits of involving in research during my student life.	
iv.	I have learnt most when involving in research in my department.	
v.	My learning has improved because of the involvement of faculty in research.	
vi.	My department and the faculty provide a conducive environment for my research experience.	

2.7 Give your feedback to improve your research experience in the department and how it can help your overall learning experience.