

EXPLORING STUDENTS' PREFERENCES FOR UNDERGRADUATE RESEARCH: A Gateway to Economic Transformation

Fayyaz Ahmad FAIZE*

Abstract

The universities in Pakistan with the support of Higher Education Commission (HEC) are expending considerable effort for promoting research based endeavour. However, there is little focus on improving Undergraduate Research (UGR) in universities despite that it represents a period of peak learning for students and offers diverse opportunities for universities linkages with local industries. The universities in Pakistan are geared around teaching with little focus on improving UGR. This research aimed at exploring research preferences of undergraduate students with the purpose of presenting a framework for improving UGR in universities in Pakistan. Data were collected through a questionnaire from 2068 students randomly selected from four large universities in Rawalpindi-Islamabad. The sample consists of undergraduate students from all disciplines, age and gender. The data were converted into percentages and cross tabs using SPSS to explore relationship between different variables. Identifying students' research preferences will help in planning UGR in universities besides increasing engagement with local industries.

Key words: economic transformation, higher education, improving research, industrial linkages, undergraduate research.

I. Introduction

Universities have assumed a significant role in the economy of the world at present [Huang and Chen (2016)]. This owes to the growth of knowledge based economy which spurts out of the research innovation by universities thereby staggering economic development of countries [Etzkowitz, et al. (2000), Laredo and Mustar (2001)]. This has become possible through establishing strong research programs in universities. One of the vital component of this research program is Under Graduate Research (UGR). However, there is little exposure to research-based engagement at Under Graduate (UG) level [Strassburger (1995)]. The result is that a large bulk of these students completes their graduation and leaves the universities in the pursuit of professional career without any exposure to research-based experience [Boyer Commission (1998)].

UGR can be understood as a research program in which the UG students are involved in original work related to some current problem beyond the scope of curriculum and which may encourage publishable material (Committee on the Undergraduate Pro-

* Head, Department of Humanities, COMSATS Institute of Information Technology, Islamabad, Pakistan. The financial support of Higher Education Commission, Pakistan, is acknowledged for funding this research.

gram in Mathematics [CUPM (2006)]. This definition makes it clear that the problem under investigation may not be related to curriculum or course of studies. The students work on solving problems which may produce new knowledge, and results in reports which can be published.

The universities are expected to contribute towards sustainable development of economy through quality preparation of students in education as well as research [Shiel, et al. (2016)]. Thus, UGR is a gateway to economic transformation and a key to economic development of countries. Due to this important role, a movement for promoting undergraduate research was started in the US in the late twentieth century. The movement gained popularity and the undergraduate research program is now a necessary part of the curriculum in most of the top universities including University of Berkeley, Boston University, the Georgia Institute of Technology, the University of California Los Angeles, the Massachusetts Institute of Technology (MIT), the University of Michigan, the University of New Hampshire and the University of Oregon.

However, universities in Pakistan are struggling in establishing a systematic and organized UGR programs for their students [Faize and Idrees (2014)]. Though, the Higher Education Commission has taken some initiative to involve students in faculty-led research projects as research assistants however, the undergraduate research still awaits proper consideration and ambitious plan of action. There are many choices to test and experiment with for improving UGR in Pakistani universities. However, students' involvement is the most significant element in UGR. The objectives of the present study were to discover how undergraduate students view involvement in UGR and to identify what students' think of working as research intern with local industry. Exploring students' preferences is very important as they are the most relevant stakeholder in this research process. Identifying students' research preferences would help in developing a framework for ensuring students' participation in research processes. This would potentially benefit the undergraduate students, the faculty, the employer and finally the country through greater industrial linkages and economic transformation.

II. Methodology

1. Design

The present study used a descriptive design of survey type. The data was collected through a questionnaire consisting of closed as well as open ended items.

2. Population and Sample

The population comprised of undergraduate students of science and social science disciplines in universities. However, due to time and resource constraints, the researcher selected universities from Rawalpindi-Islamabad only.

The study involved multi-stage sampling technique. In the first phase, four universities were randomly selected in the twin cities. For this purpose, the universities were assigned serial numbers and then four randomly generated numbers were drawn out using online random number generator website of Stat Trek.¹ The universities with the corresponding serial numbers were thus included in the list of sample universities. In the second stage, the students were selected from each university through convenience sampling technique. The Permission was sought from university administration to allow collection of data from the students in their classes, in the ground, or students' cafe with the purpose to reach as many students as possible. Convenience sampling is a non-probability sampling that helps in collecting data from participants because they are easily accessible, or willing to participate in the study [Etikan, et al. (2016)]. The limitations of using convenience sampling such as high sampling error and biases were overcome as the sample characteristic was uniform i.e. students of undergraduate level which was of interest to this study. In this way, a large number of students were included for collection of data from each university (Table 1). Some questionnaires were omitted due to incomplete data. The total number of valid questionnaires used for data analysis, were 2004.

The data collection was not gender specific. The data were collected without any consideration to gender as the research was focussed on students' preferences. It was after collection of data from the students that a gender wise comparison was made to find if there is any significant difference in the preferences of students gender wise.

The number of students' gender wise and their university is shown in Table 1. The number of female students was greater in universities as compared to boys. The percentage of female students in the sample was 55.5 per cent as compared to 44.5 per cent male students. Only, in Szabists the male students were considerably more than female students. The enrolment rate is shifting in favour of female students in universities.

TABLE 1
Sample of Students from each University

Name of University	Gender		
	Male	Female	Total
COMSATS	86	346	432
Arid	174	370	544
NUML	342	334	676
Szabists	318	98	416
Total	920	1148	2068
% of Total	44.5	55.5	100.0

¹ <http://stattrek.com/statistics/random-number-generator.aspx>

3. *Research Instrument and Data Analysis*

The research study used questionnaire for collection of data. The questionnaire items were validated by five experts and then pilot tested. The items were further refined and improved after pilot testing. The questionnaire consisted of items asking students to express their research preferences. The responses of students were converted into percentages gender wise and chi square values was calculated using cross tabs to find the preferences gender wise at .05 significance level. The last item in the questionnaire was open ended to give a qualitative dimension to data interpretation. The item asked for students' motive and expectation from involving as research intern with the local industry. The frequency of students' responses was categorized and then converted into percentages to rank preferences.

III. Results and Discussion

In order to develop a framework for improving UG research in universities and to help strengthen industries-academic linkages for improving economic activities, a systematic exploration of students' preferences was carried out. The responses of the students were tabulated in a single large table to observe preferences in totality (Table 2).

The first item sought students' views on research internship in industry. The result indicated significant association between gender and willingness to work as intern in industry ($\chi^2 = 19.31, p < .05$). Both gender preferred to work in the industry as research intern which shows students' interest in research. The same is reported by Faize and Idrees (2014); however, Munir and Bolderstone (2009) found that students lack interest in research. The result also indicated that more female students were willing to work in industry than male students. This contradicts Tartari and Salter (2015) that female have less preference for engagement with industry due to their domestic responsibilities. The female students in present study expressed greater preference to engage in industry as compared to male students.

In order to explore the future plan of UG, there existed a significant association between gender and their future plan ($\chi^2 = 16.28, p < 0.05$). The relationship is predictable for both the genders expressing that they will continue their studies by enrolling in MS/PhD program after doing their bachelor. This is an important result and needs to be taken into consideration by our universities and employers to plan and cater to the future needs of our students. There was less preference for searching job or any other plan. Ona (2015) also found that students having research capabilities are more likely to opt for higher studies and life-long learning. The preference for enrolling in higher studies signifies students' motivation and interest for research based engagements as found by Elgren and Hensel (2006), and Russell, et al. (2007). Similar finding is also reported by Lev, et al. (2010) that UG students pre-

ferred to pursue higher studies as a developing trend in the present decade. Kitutu et al. (2016) and, John and Creighton (2011) also found similar result in their study on UGR.

There was a significant association between gender and time management ($\chi^2 = 11.47, p < 0.05$). As majority of male and female students responded positively on time management, so there is no problem of time management with students if they are engaged in research internship with industry. The university students gave more time to their academic studies [Wade (1991)]. However, the above finding contradicts Ruiz-Gallardo, et al. (2016) that university students struggle with time management and majority students cannot manage time thus resulting in academic failure and frustration (Longman and Atkinson, 2004). However, the female students have a higher percentage (86.7 per cent) as compared to male students (81.2

TABLE 2
Exploring Students' Preferences on Involvement in UGR

Students' Preferences		Male (%)	Female (%)	Total (%)	Chi square
Willing to work as research intern with local industry	Yes	85.3	89.6	87.5	19.31, $p < .05$
	No	14.7	10.4	12.6	
	Opt for Job	33.4	35.5	34.6	
Future plan after passing bachelor	Enrol in MS/PhD	52.6	56.5	54.7	16.28, $p < .05$
	Any other	14.0	8.0	10.7	
Managing time effectively if join a research internship	Yes	81.2	86.7	84.3	11.47, $p < .05$
	No	18.8	13.3	15.7	
	1 month	52.9	54.4	53.7	
Prefer duration of research internship	4 months	24.2	26.9	25.6	31.96, $p < .05$
	> 4 months	22.9	18.7	20.7	
Prefer time of year for research internship	During Semester	53.9	44.8	49.4	16.33, $p < .05$
	Summer vacation	46.1	55.2	50.7	
Prefer days for involvement in research internship	Weekdays	46.9	49.8	48.4	1.71, $p > .05$
	Weekends	53.1	50.2	51.6	
	Field research	67.3	59.4	61.4	
Prefer type of research work	Lab research	22.6	27	24.8	14.26, $p < .05$
	Desk research	10.1	13.6	11.9	

per cent). This was surprising keeping in mind that there is more time restriction for female students in Pakistani society. Involving UG students in research improve their time management skills [Bauer and Bennett (2003)]; however, our students have expressed no problem with time management before actually engaging in UGR which was very encouraging.

There was a significant association between gender and project duration ($\chi^2 = 31.96$, $p < 0.05$). The most preferred project duration for both the gender was one month. The project duration more than a month was not preferred by both the genders.

There was a significant association between gender and preference for the time of year for research participation ($\chi^2 = 16.33$, $p < 0.05$). The findings revealed that the male students preferred research work during semester (53.9 per cent) while female students (55.2 per cent) preferred summer vacation for research involvement. Perhaps, the female students think that they will have ample time during summer vacation in which they can work in research related tasks. It shall be kept into consideration that the summer program demands more time from students as compared to research during semester [Vessey and DeMarco (2008)]. Many UG students preferred research during summer as they can take a paid position to take some economic benefit [Webb (2007)]. One advantage of involving students during summer semester is that besides involving student as full time intern, they also get more opportunities for research learning [Cepanec, et al. (2013)]. The students may even continue research internship after summer vacation due to research motivation and improved relation with their mentor [Slattery et al. (2016)].

There was no significant association between gender and preference for days of the week ($\chi^2 = 1.71$, $p > 0.05$). Thus, it is not predictable which gender will prefer which days of the week for research involvement. The views of both the gender were divided. Both male and female students equally prefer weekdays and/or weekends for research involvement. It can be concluded that students can be involved in weekdays or weekends in research projects. Such kind of involvement would lessen the academic stress and would make students learn better [Kitutu, et al. (2016)].

There was a significant association between gender and the kind of research work ($\chi^2 = 14.26$, $p < 0.05$). Both the gender preferred field research as compared to lab research. The preference for field work in female students was an encouraging trend in a society where the socio-cultural norms do not prefer females to work outside. The desk work was not preferred by both the genders. It seems that the students have enough of their desk work in the form of studies/course work; thus making they prefer field work. The findings of Stephens (2009) also supported students' preference for field work as being more interesting than the class work. Kelvin (2011) reported that field work is preferred because it helps in observing people or organizational behaviour and implies less control over variables as compared to lab research. While Viceisza (2012) even supported treating field as a lab, especially for students studying economics problems and issues.

Thus, it can be concluded that both male and female students can effectively manage their time even if they are involved in research based activities. The students have a high preference for continuing their studies after passing their UG level and would enrol in MS/PhD program. The UG students are willing to work as research intern with local industry. The preferred duration of working on research internship is one month. The students do not prefer longer duration of research internship. As regarding time of year, the male students prefer research internship during summer while the female students prefer research work during summer vacation. Both the gender can be involved during weekdays and/or weekends. The students prefer field research as compared to research in lab or desk/library research. Keeping in mind these preferences, the universities shall provide ample opportunities in the light of above preferences for strengthening UGR and industrial collaboration.

1. Open-ended Item

The students responded differently on the open-ended item. The item sought to explore what the students expect from involvement in research internship with local industry. The item helped in understanding students' research motives from a wider perspective and the reason for involving in research internship (Figure 1).

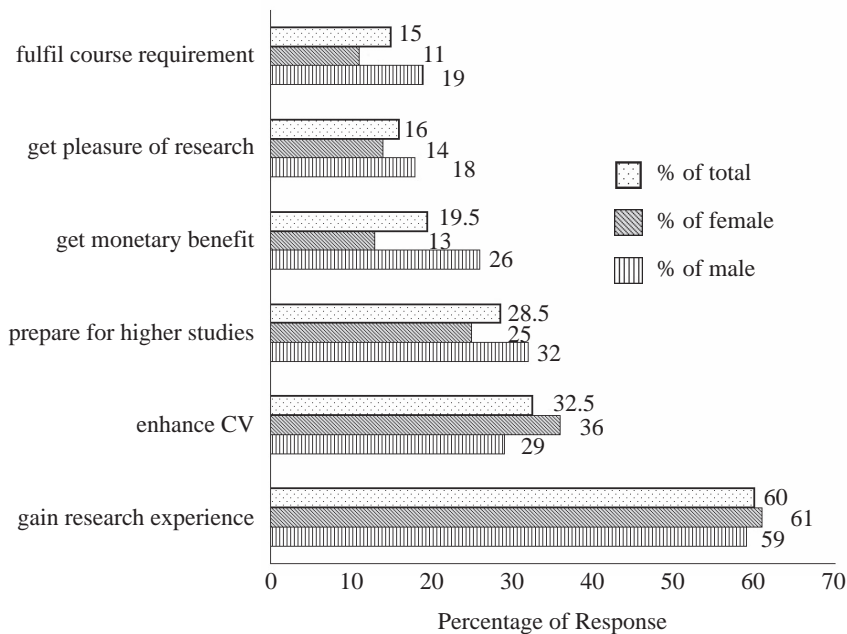


FIGURE 1

Students' Expectation from Involvement in Research Internship

The frequency of students choosing a particular response was categorized, counted and then converted into percentages. 60 per cent of students expressed that they like to improve their research skills and knowledge through involvement in research internship. The students expressed that they would be interested in learning about data interpretation and project implementation during their research internship with industry. One female student expressed, 'My family would allow me to go and work as research intern as this would help me in getting better job experience'. This confirms the findings of Slattery et al. (2016) that students like to explore opportunities for data analysis and decisions related to project implementation during their internship involvement. Research involvement make students work independently and contribute new knowledge into their field [John and Creighton (2011)].

Some students also mention that they want to enhance their CV by involving in research based engagements. The female students had a greater percentage for improving their CV compared to male students. A major reason for improving CV profile is to increase one's chances of getting earlier and good jobs [Slattery et al., (2016)] through improving research skills [John and Creighton (2011)]. This is also consistent with the findings of Behar-Horenstein, et al. (2010).

Equally interesting was students' choice to prepare for higher studies by working as research intern (28.5 per cent students). This is supported by Ona (2015) and Kitutu, et al. (2016) that involvement in UGR will help the students in preparing for post graduate education. 19.5 per cent students expressed to get some monetary benefit from research involvement. The interesting aspect was that the percentage of male students seeking for monetary benefit was almost double of female students. This is a realistic response as students do expect financial benefit to meet their education expenses which shall be provided through project funding [Alayont, et al. (2014), Galian and Higgins (1999)]. The findings of Webb (2007) also supported financial benefit for students as research intern. However, the monetary benefit shall not be over emphasized in research internship [O'Clock and Rooney (1996)]. Some students opined that they want to get pleasure out of research involvement and some expressed that they just want to meet the course requirement by involving in research internship. But the frequency of these preferences was very less (around 15 per cent).

IV. Conclusion and Limitations

1. Conclusion

The strongest economies in the present world are driven by knowledge as compared to traditional inputs [Guerrero, et al. (2015)]. This requires a renewed focus on improving higher education research especially UGR. Exploring research preferences of UG students will provide a different perspective towards improving UGR in universities in Pakistan. The students' preferences from the present study can be

incorporated into a framework for improving UG research. This will alternatively help in improving human research capital which will finally pass to the local industry for stimulating economic development [Lazzeroni and Piccaluga (2003)]. This is in line with the new emerging role of universities as a hub of economic and commercial activities through intensive industrial linkages [Martin (2003) Huang and Chen (2016)].

2. Limitations

The study focussed on exploring research preferences of UG students only which limits the generalizability of the findings. In order to have greater reliability in the results, the data may be collected from relevant faculty members, university administration and the professionals associated with industry. Moreover, the researcher used questionnaire for collection of data. Future researches may use different research instruments for triangulation and collecting diverse type of data for improving UGR and industrial linkages.

*COMSATS Institute of Information Technology,
Islamabad, Pakistan.*

Bibliography

- Alayont, F., Y. Babenko, C. Jackson and Z. Szanislo, 2014, Challenges in promoting undergraduate research in the mathematical sciences. *Involve*, 7(3): 265-271.
- Bauer, K.W., J.S. Bennett, 2003, Alumni perceptions used to assess undergraduate research experience, *Journal of Higher Education*, 74: 210-230.
- Behar Horenstein, L.S., K.W. Roberts and A.C. Dix, 2010, Mentoring undergraduate researchers: An exploratory study of students' and professors' perceptions. *Mentoring and Tutoring: Partnership in Learning*, 18(3): 269-291.
- Boyer Commission, 1998, Reinventing undergraduate education: A blueprint for America's research universities, Stony Brook: State University of New York at Stony Brook.
- Cepanec, D., D. Clarke, J. Plohman and J. Gerard, 2013, Engaging undergraduate nursing students in research: The students' experience of a summer internship program, *Journal of Nursing Education*, 52, (8), 466-469.
- CUPM, 2006, Committee on the undergraduate program in mathematics, Mathematics research by undergraduates: costs and benefits to faculty and the institution: A report of the Mathematical Association of America, CUPM subcommittee on research by undergraduates, MAA 2006, available at <http://www.maa.org/sites/default/files/pdf/CUPM/CUPM-UG-research.pdf>.
- Elgren, T., and N. Hensel, 2006, Undergraduate research experiences: Synergies between scholarship and teaching, *Peer Review*, 8(1): 4-7.
- Etikan, I., S.A. Musa and R.S. Alkassim, 2016, Comparison of convenience sampling and purposive sampling, *American Journal of Theoretical and Applied Statistics*, 5(1): 1-4.
- Etzkowitz, H., A. Webster, C. Gebhardt, B.R.C. Terra, 2000, The future of the university and the university of the future: Evolution of ivory tower to entrepreneurial paradigm, *Research Policy* 29 (2): 313-330.
- Faize, F. A., and S. Idrees, 2014, Undergraduate research is getting harder-not for Pakistani students, *European Scientific Journal*, 10(1): 425-434.
- Gallian, J.A., A.W. Higgins, 1999, Helping students present their research, in: J.A. Gallian, 2000, Proceedings of the conference on summer undergraduate mathematics research programs, American Mathematical Society, US.
- Guerrero, M., J.A. Cunningham, and D. Urbano, 2015, Economic impact of entrepreneurial universities' activities: An exploratory study of the United Kingdom. *Research Policy*, 44(3): 748-764.
- Huang, M.H., and D.Z. Chen, 2016, How can academic innovation performance in university – industry collaboration be improved? *Technological Forecasting and Social Change*, <http://dx.doi.org/10.1016/j.techfore.2016.03.024>.
- John, J., and J. Creighton, 2011, The impact of undergraduate research opportunity programmes on students in the UK. *studies in higher education*, *Researcher Development*, 36(7): 781-797.

- Kelvin, 2011, Lab research vs field research, Retrieved from <https://kcmoon-walker.wordpress.com/2011/10/14/lab-research-v-s-field-research/>
- Kitutu, J., M. McCall, R. Findle, K.F. Mahmoud and W.B. Greene, 2016, Beyond one term of mentoring: A new approach to the research mentorship of undergraduate students, *International Journal of Nursing Sciences*, 30: 1-8.
- Laredo, P., P. Mustar, 2001, *Research and innovation policies in the new global economy, An international comparative analysis*, Edward Elgar, Cheltenham.
- Lev, E.L., J. Kolassa and L.L. Bakken, 2010, Faculty mentors' and students' perceptions of students' research self-efficacy, *Nurse Education Today*, 30(2): 169-174.
- Longman, D.G., and R.H. Atkinson, 2004, *College learning and study skills*, 7th ed., Wadsworth Publishing Company.
- Martin, B.R., 2003, The changing social contract for science and the evolution of the university, in: Geuna, A., A.J. Salter, W.E. Steinmueller, eds., *Science and innovation rethinking the rationales for public funding*, Edward Elgar, Cheltenham, UK.,
- Munir, N., and A. Bolderston, 2009, Perceptions and attitudes toward conducting research: A nuclear medicine student perspective, *Journal of Medical Imaging and Radiation Sciences*, 40(4): 183-189.
- O'Clock, P.M., and C.J. Rooney, 1996, Exposing undergraduates to research through a mentoring program, *Journal of Accounting Education*, 14(3): 331-346.
- Ona, A., 2015, Professional aspirations in students with technical T\alent., *Procedia-Social and Behavioral Sciences*, 191: 1881-1885.
- Ruiz-Gallardo, J. R., J.L. González-Geraldo, and S. Castaño, 2016, What are our students doing? Workload, time allocation and time management in PBL instruction, A case study in science education, *Teaching and Teacher Education*, 53: 51-62.
- Russell, S.H., M.P. Hancock, and J. McCullough, 2007, Benefits of undergraduate research experiences, *Science*, 316(5824): 548-549.
- Shiel, C., W. Leal Filho, A. do Paço, and L. Brandli, 2016, Evaluating the engagement of universities in capacity building for sustainable development in local communities, *Evaluation and Program Planning*, 54: 123-134.
- Stephens, A., 2009, *The effects of fieldwork on student achievement and motivation in science education*, Northridge: California State University.
- Strassburger, J., 1995, Embracing undergraduate research, *American Association of Higher Education Bulletin*, 47(9): 3-5.
- Tartari, V., and A. Salter, 2015, The engagement gap: Exploring gender differences in University-Industry collaboration activities. *Research Policy*, 44(6): 1176-1191.
- Vessey, J.A., and R.F. DeMarco, 2008, The undergraduate research fellows program: A unique model to promote engagement in research, *Journal of professional nursing*, 24(6): 358-363.

- Viceisza, A.C., 2012, Treating the field as a lab, International Food Policy Research Institute.
- Wade, B.K., 1991, A profile of the real world of undergraduate students and how they spend discretionary time, Annual meeting of the American Educational Research Association, Chicago.
- Webb, S.A., 2007, The importance of undergraduate research. retrieved from <http://www.sciencemag.org/careers/2007/07/importance-undergraduate-research>.