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Research Article

Assessment of Academic Knowledge Transfer Practices in Field of Environment

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Abstract

Background and Objective: Production of research knowledge and its transfer have been shown at increased level of researchers' interest. However, facts show fewer types of knowledge transfer practices adopted in the developing countries. **Materials and Methods:** For making empirical evidence available about knowledge transfer practices, this article makes assessment of the transfer practices of academic research of the PhD faculty members of universities offering degrees in field of Environment in Sindh Pakistan. The identified 28 practices of academic knowledge transfer have been grouped together based on their characteristics by making 7 clusters as, publications, networking, mobility of researchers, joint research, intellectual property and co-operations including spin-off companies and sharing of equipment. At the end, comparison between clusters of knowledge transfer practices is presented. **Results:** According to research findings, publications in terms of research papers in journal, networking and co-operations are found to be common practices of academic knowledge transfer. However, less number of academic knowledge has been transferred through other practices of knowledge transfer such as, Intellectual Property and joint research programs. **Conclusion:** This article contributes empirical results of academic knowledge transfer practices in universities in field of environment, with some particular policy implications such as, to enhance the production of professional publication, improvement of alumni organizations, industry people engagement in the academic events, enhancement of absorptive capacity of highly qualified graduates, structuring policies and infrastructure to support the commercialization of academic knowledge, favor of academic work in co-operation and development of mechanisms and infrastructure for development of university spin-offs and development of efficient TTOs.

Key words: Knowledge transfer, academic research, environment

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

It is well understood that the creation and utilization of new knowledge is the essential factor that drives the national development. This study looks at parts of transfer practices rehearse from universities¹. Information exchange can be characterized as the methods by which aptitude, learning, abilities and capacities are exchanged from the information base (for instance, universities, research focuses or investigate association) to those needing that learning, for instance, businesses, social undertakings or not-for-profit association². Information trade, synergistic examination, activity research, participatory exploration, group based participatory, coproduction of learning, or mode 2 research, includes dynamic coordinated effort and trade amongst analysts and learning clients all through the examination procedure from distinguishing and molding the examination inquiries to gather information, decipher discoveries, scatter and apply the outcomes³. Nature of university-industry interfaces may be a key component in advancing development, the mind boggling and differed nature of such interfaces should be comprehended and investigated⁴. A coordinated methodology is possibly additional tedious, requesting and asset serious than different systems since it requires both scientists and information clients to grow new abilities, learning and points of view. In any case, effectively including learning clients as accomplices in the exploration procedure are solid indicators that the examination discoveries will be utilized and that the analysis attempt generally speaking will accomplish a more noteworthy effect⁵.

The term knowledge exchange and its scattering is focused on exploration to groups of end users. Information exchange exercises ought to be deliberately and fittingly considered and illustrated in a dispersal arrangement concentrated on the necessities of the end users. It is well demonstrated that scholastics add to development exercises chiefly by creating additional information in specific fields and offering practical help and assistance⁴. Seven key advantages from open exploration for advancement have been recognized from past Science and Technology Policy Research (SPRU) surveys: (1) Delivering new investigative data, (2) preparing gifted graduates, (3) Supporting new exploratory systems and animating communication, (4) Growing the limit for critical thinking, (5) Creating new instrumentation and approaches/procedures, (6) Making new firms and (7) Giving social information⁶. The knowledge dispersal of the learning interpretation prepare that incorporates amalgamation, scattering, trade and morally solid use of learning⁷. The

activities of university scientists are described as a compelling approach to exchange learning from universities to firms⁸.

The best commitment of the scholarly world to advancement appears as roundabout and elusive streams of thoughts, information and master help⁹. Synergistic and contracted exploration exercises seem, by all accounts, to be an a great deal more imperative type of information¹⁰. Counting it, casual contacts are frequently observed to be a typical type of connection amongst universities and industry¹¹. In spite of the fact that, there are different sorts of coordinated efforts, they are all portrayed by a trade of learning among stakeholders¹². The different types of industry-academia linkages can bring about an assortment of yields including new instrumentation, philosophies, models, licenses, turn offs. Because of the assortment of exercises and yields, no single measure is completely ready to catch the complete scope of industry-academia coordinated efforts¹³. Shared connections based on trust and incessant cooperation amongst specialists and learning clients are key determinants of effective trade and dispersal endeavors. As creative ways to deal with trade and spread develops and advances, expanding center must be put on creating markers to assess these procedures and on thoroughly assessing their viability on applicable short, medium and long haul results⁷. Industry the educated community cooperation has turned into a subject of awesome enthusiasm to scholastics, industry pioneers and policymakers, as it is presently recognized that such connections are significant for development. New and financially helpful information is the aftereffect of communication and learning forms among different performing artists in the development frameworks, i.e. makers, clients, suppliers, open powers and exploratory establishments¹⁴.

Despite the fact that, there are different practices by means of which data and expertise are exchanged amongst university and industry. These incorporate formal and casual, planned and spontaneous, immediate and aberrant practices. Thusly, they can be in type of systems, including groups of practice, information systems and delicate systems are conceivably successful components for learning spread and application in light of the fact that their key design is to associate individuals who may not generally have a chance to cooperate, empower discourse, invigorate learning and catch and diffuse information. A people group of practices is a gathering of individuals who share a typical concern, an arrangement of issues, or enthusiasm for a point and who meet up to satisfy both individual and gathering objectives normally centered around enhancing proficient practice. The absence of association amongst scientists and their

potential gatherings of people have been distinguished as the primary issue in underutilizing research discoveries, in this circumstance¹⁵. Learning use relies on upon muddled co-operations amongst specialists and clients, instead of on straight groupings starting with the necessities of analysts or the requirements of clients. The supporters of these clarifications anticipate that the more maintained and extreme the association amongst scientists and end users, the more probable usage will happen. Dissimilar to earlier clarifications, this point of view recommends giving more noteworthy consideration regarding the connections amongst analysts and clients at various phases of learning generation, dispersal and usage. The most intriguing arrangements of markers of components connecting analysts and clients incorporate casual individual contacts, cooperation in councils and the transmission of reports to nonacademic associations. The more assets the clients and analysts put resources into these sorts of linkage components, the higher utilization of examination since, information usage is not an occasion, but rather a procedure which involved different practices of learning exchange¹⁶.

Although, there are various ways in which academics contribute to innovation, there is widespread gap of research in many developing countries. This article offers additional contribution in literature, achieving the research objectives which make focus to analyze the current practices of academic research knowledge transfer in the universities of Pakistan which offer degrees in environment sector. To achieve research objective; 7 clusters of knowledge transfer practices

with 28 factors such as; publications (2, factors), networking (4, factors), mobility of researchers (6, factors), joint research (5, factors) intellectual property (2, factors) and co-operations (6, factors) including spin-off companies, sharing of equipment and role of technology transfer offices (3, factors) are used for assessment. Clusters of knowledge transfer practices assessed in this research are shown in Fig. 1. Detailed discussion related to practices included in the clusters and their factors already have been discussed in the above section. Selected knowledge transfer practices are identified from the review of literature and their clustering is taken from study done by Bekkers and Freitas¹⁷ analyzing knowledge transfer practices between universities and industry making identification of knowledge transfer practices in different sectors. By making addition in literature this study will assess existence of knowledge transfer practices including another addition of cluster related to co-operation between researchers and their end users identified from the literature.

Following this introduction, the rest of the paper is structured as follows, Section 2 presents discussion related to material and methods used in this research, selection of sector and cases and instrument development its components and analyzing methods are discussed. Section 3 provides the context of the study with current research and knowledge transfer practices from academia to end users and offering results related to comparison of knowledge transfer practices. Section 5 concludes the paper with discussions based on findings from the results, identifying implications for the research policy and future research directions.

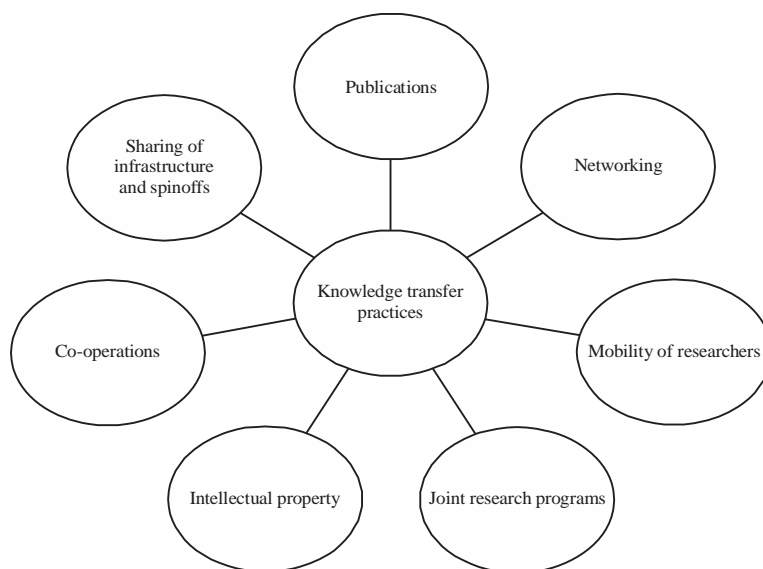


Fig. 1: Clusters of academic knowledge transfer practices

MATERIALS AND METHOD

This research focuses on analyzing academic research transfer produced by PhD faculty members working in universities of Sindh offering degrees in field of environmental engineering and environmental sciences using case study approach. It was a detailed examination of a subject of study which involves variety of research techniques involving an up-close, in-depth, as well as its related contextual conditions¹⁸. From total 8 numbers of identified universities offering degrees in field of environment, 3 universities offer degrees in environmental sciences and 5 offer degrees in environmental engineering. In terms of highly qualified faculty there are 24 PhD faculty members 12 working in the universities offering degrees in environmental engineering and 12 in environmental sciences.

Structured research instrument has been developed to collect the required data in this study. From total 24 PhD faculty members, 23 In-depth interviews up to an hour were held with individual respondents on the time availability of respondents during July 2015 to December 2015. Research instrument comprised of seven clusters of knowledge transfer practices including their 28 sub factors of each cluster have been analyzed. Data have been analyzed using SPSS (Statistical Packages for Social Sciences) Version. 20 making descriptive statistics, pie and bar charts and cumulative means have been built obtained required results. Next section will discuss the obtained results.

RESULTS

Responses related to transfer practices of academic knowledge have been collected using developed research instrument. In the data collection respondent were asked how they assess their knowledge transfer through identified practices on three pointing rating scale, ranging from Scale: 1 = Never Transferred, 2 = Slightly Transferred, 3 = Transferred at most. Discussion of this section is based on the results

related to knowledge transfer practices by making assessment of practices merged in seven clusters. At the end, comparison between clusters is presented. Results are based on empirical data obtained from the interviews with selected cases of PhD faculty members of universities in field of environment. Detailed results are discussed below.

Assessment of knowledge transfer practices: Academic knowledge was transferred to their end users through different practices. This section will present assessment of practice through which PhD faculty members have transferred their academic knowledge.

Knowledge transfer through publications: Publications are considered as the most frequent practice of knowledge transfer in the academic environment.

Figure 2 shows that academic knowledge was transferred through publications. But making comparison between scientific publications in the refereed journals at larger number with 2.9 mean values, academic knowledge is slightly transferred through professional publication with 2.1 mean value.

Knowledge transfer through networking of scientific community: After publication networking is the most common practice of knowledge transfer in the academic environment. Networking was may be done, through professional and alumni organizations or it is done through informal contacts of faculty members and participation of industrialist and policy makers in academic event.

Results presented in the Fig. 3 shows that knowledge transfer through participation of industry staff in the academic events with 2.3 mean values was most common factor of knowledge transfer than the others. Knowledge transfer through alumni organizations with 1.4 mean value presents least level in the knowledge transfer practice factors included in the cluster of networking.

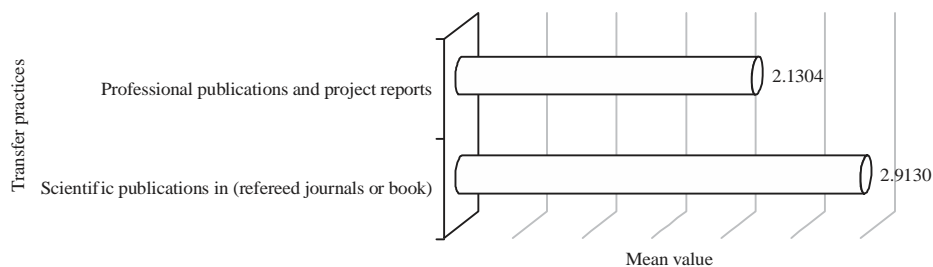


Fig. 2: Knowledge transfer through publications

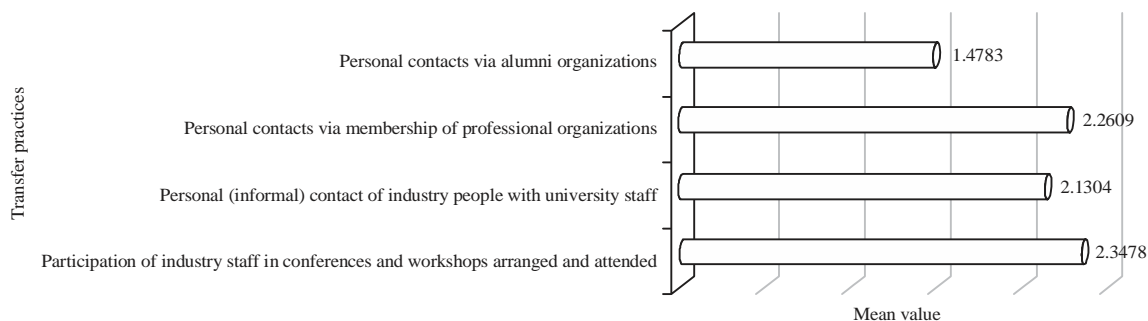


Fig. 3: Knowledge transfer through Networking

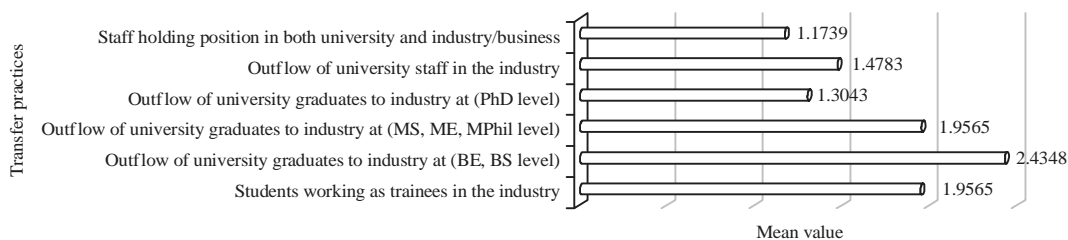


Fig. 4: Knowledge transfer through mobility of researchers

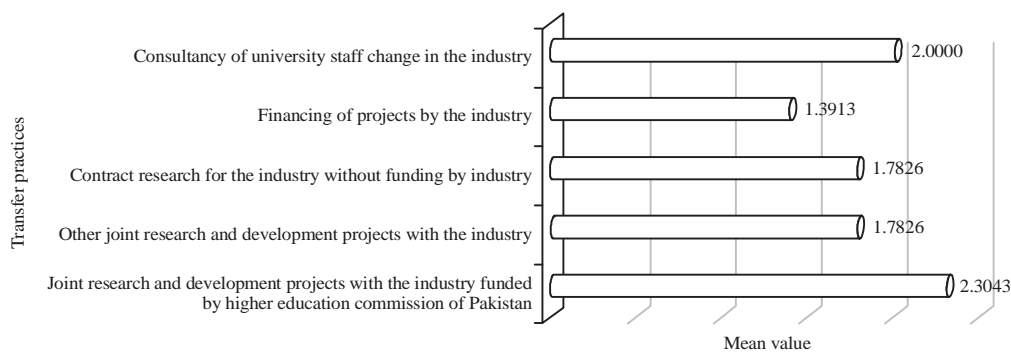


Fig. 5: Knowledge transfer through joint research projects

Knowledge transfer through mobility of researchers:

Academic knowledge was embedded in scientific publications, inventions and by means of human resources. Knowledge transfer in terms of mobility of researchers was most common practice of knowledge transfer from academia to industry in the literature. Researchers move towards industry at different academic levels and purposes.

Results presented in Fig. 4 shows the high frequency of university graduate to industry after bachelor level of education with 2.4 mean value, following the mobility of graduates as trainees and after masters level of university education with 1.9 mean value. In rare cases researcher’s mobility was done by means of staff holding position at both

university and industry, university staff outflow towards industry and placement of university graduate in industry after PhD level of qualification.

Knowledge transfer through joint research projects:

Research has the greatest potential to impact change in practice and policy when it was conducted in collaboration with practitioners rather than conducted by an academic researcher alone.

Results presented in Fig. 5 shows that joint research was done in terms of joint research and development projects of universities and industries under program joint research funded by Higher Education Commission of Pakistan (HEC)

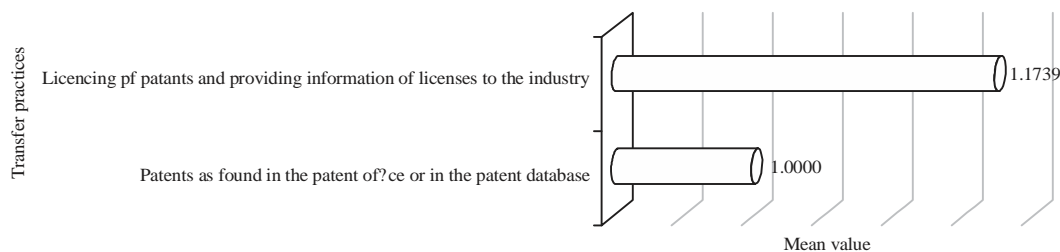


Fig. 6: Knowledge transfer through intellectual property

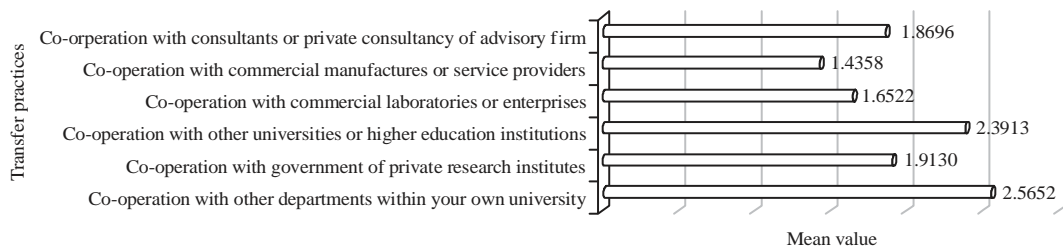


Fig. 7: Knowledge transfer through Co-operations

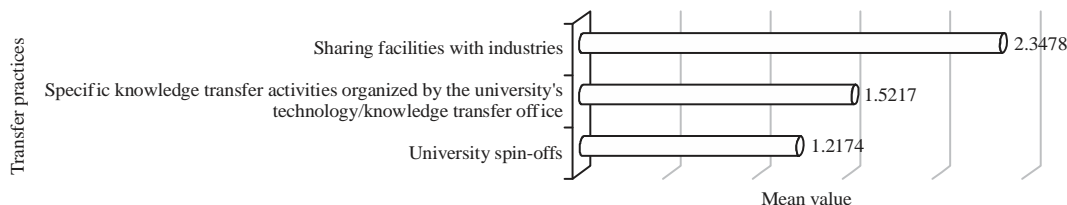


Fig. 8: Knowledge transfer through infrastructure of university

and consultancy of university staff to industry with mean value ranging up to 2. Less number of joint research work have been identified through financing of research projects by industry.

Knowledge transfer in terms of intellectual property:

Intellectual property is now emerging as most valuable practice of academic knowledge transfer to enhance the impact of academic knowledge towards society in terms of products, services and getting financial benefits.

Results presented in the Fig. 6 shows that, knowledge in terms of intellectual property is not transferred from universities.

Knowledge transfer through co-operations: Co-operations of scientists within their institutes and other academic institutes, industries are seen as knowledge transfer practice from university to industry.

Results shown in Fig. 7 present that, faculty members are working in terms of different types of co-operations. Most of the co-operations have been identified in terms of faculty

co-operation within other departments of their universities and other academic institutes showing 2.5 mean values, less number of co-operations of PhD faculty members have been identified with commercial production units.

Knowledge transfer through sharing of infrastructure and spin-offs from universities:

Knowledge can be transferred through working on the equipment of industry people is shown at high level of frequency than the others showing 2.3 mean values presented in the Fig. 8. Rarely academic knowledge has been transferred through specific knowledge transfer activities organized by technology transfer offices and in terms of development of university spin-offs. Results related to assessment of individual knowledge transfer practices has been discussed in this section, next section will offer comparison between clusters of knowledge transfer practices.

Comparison between clusters of knowledge transfer practices:

The analysis related to comparison of clusters of knowledge transfer practices have been done to explore most

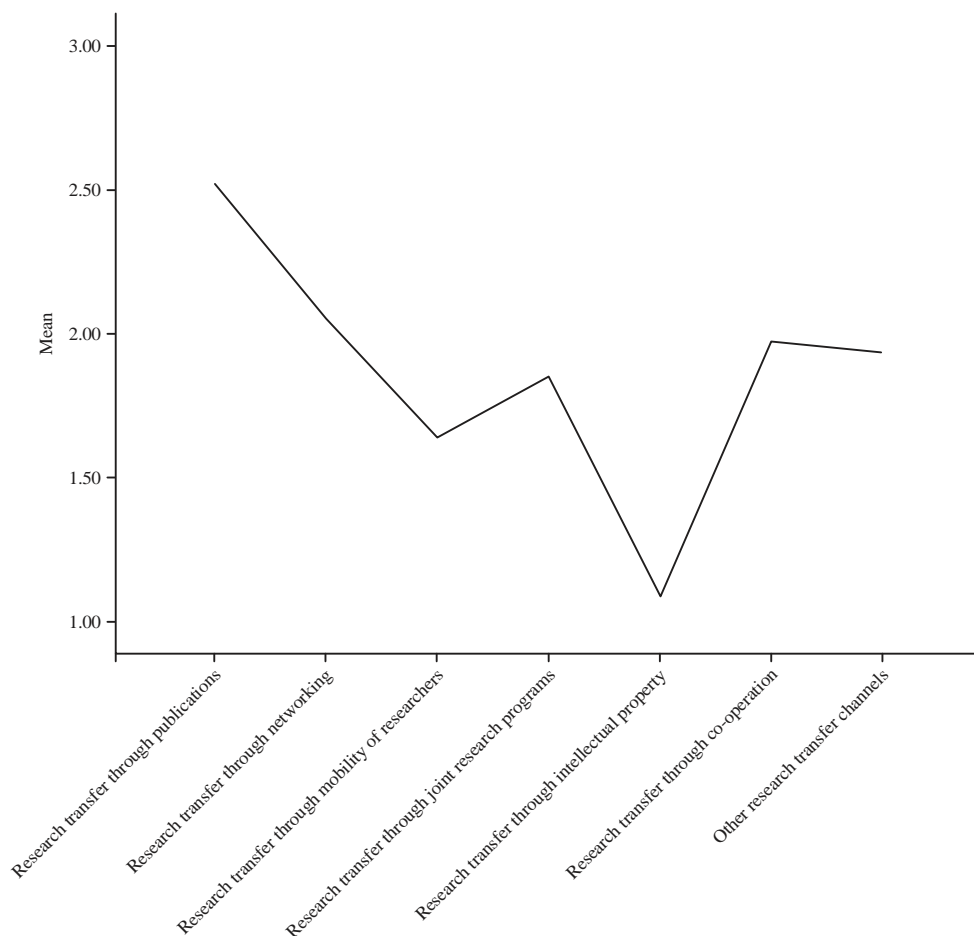


Fig. 9: Comparison between clusters of knowledge transfer practices

common and least practices of knowledge transfer by the PhD faculty members. Required results are obtained by computing mean values of practices included in each cluster.

Results presented in Fig. 9, shows high frequency of knowledge transfer through, publications at larger scale than the joint research work and co-operation of academic staff while in opposite to it, knowledge have been transferred through intellectual property at least level than the knowledge transfer through mobility of researchers and development of spin off companies.

DISCUSSION

It is likewise normally acknowledged that universities are an essential wellspring of new learning, particularly in the ranges of scientific development for innovation. Therefore, it is critical to work as clear picture as could be allowed of the components by which academic research moves into the economy¹. First cluster of knowledge transfer practices is related to publications and research concludes that, scientific

publication is seen as the most common practice of knowledge transfer, it shows that university policies are going in right way to produce the publications but along with less number of publications have been identified in terms of professional publications, policy making organizations should make policies to enhance the production of professional publications. The knowledge exchange gets to be critical piece of advancement where universities as a learning creating and dispersing organizations assume a bigger part in the national improvement¹⁶. In the cluster two of practices of knowledge transfer; networking of faculty members has been assessed. Research has presented networking of faculty with people of industry and related organization through their engagement in the events organized in universities. Networking through alumni organizations are seen as less effective mode of networking. To develop networking of faculty; universities and other policy making organizations have to focus on the improvement of alumni organizations to make it efficient and also work for the enhancement of industry people engagement in the academic events and

environment related to engagement of academicians in the industry event should develop; because practices included in this cluster are seen as less effective in practice.

The third cluster is focused on the mobility of researchers. It is also an important knowledge transfer practice in which knowledge flows in terms of human resource, research concludes it as less effective in the existing environment. To improve the mobility of researchers at level of high qualification new policies and programs should be developed. Its enhancement needs absorptive capacity of highly qualified graduates in the industries and other field relevant organizations. The fourth cluster which is comprised group of knowledge transfer practices related to joint work of academicians with industry people. Work in collaboration is also considered as most important practices of knowledge transfer in which both academicians and industrialist and other related bodies transfer their expertise with each other. Projects on the joint research programs initiated by HEC is showing high frequency while others are seen at very less level of existence and needs to be improved by working on the industrial needs and development of universities' capabilities.

Knowledge transfer practices included in cluster of intellectual property rights are focused towards assessment of knowledge transfer by means of licensing and patents granted to universities. Research concludes existing academic environment is less facilitating. These practices can be developed structuring policies and infrastructure to support the commercialization of academic knowledge. Works done with the co-operation of personnel's of same organization and also with the other organization enhance the quality of work by increasing its utility. Finding related to cluster of knowledge transfer practices related to co-operation of faculty within the same organization and also with the other organizations. As findings concludes less co-operation of faculty members with the outside organizations. Policies should be developed in favor of academic work in co-operation to increase the level of work in co-operation in the universities. At the end cluster of knowledge transfer related to sharing of equipment and other infrastructure by academicians and their end users, role of Technology Transfer Offices (TTOs) in knowledge transfer and assessment related to university spin-offs have been done. Article concludes sharing of facilities as effective knowledge transfer practice while universities and their policy making organizations have to work for development of mechanisms and infrastructure for development of university spin-offs and development of efficient TTOs.

Selected cases are the PhD faculty members in universities offering degrees in field of environment in Sindh,

Pakistan. Selected degree program is offered by the public sector universities of Sindh Pakistan; that is the reason all selected cases of PhD faculty members belong to Public sector universities of Pakistan. As public sector universities are more near to follow the policies of government and related governing bodies, on the basis of sector research findings present the output of government policies related to knowledge transfer in terms of knowledge transfer practices. The era and exchange of investigative academic information are non-direct procedures of issue distinguishing proof and examination, correspondence, connection and learning by and among the different accomplices in the advancement procedure^{6,16}. Findings of research offer implications for policy making in field of higher education, universities and researchers both at national and international level. The capabilities of research producing organizations and infrastructure required for knowledge transfer should be improved for enhancing role of universities in national development. Research should help researchers, research funding bodies, policy makers and practitioners in analyzing practices of knowledge transfer for development. This article was focused towards academic field of environment. Future research can be done to analyze knowledge transfer practices in other academic fields of study.

CONCLUSION

Assessment of knowledge transfer identified as less focused area in the literature related to developing countries. The existing levels of knowledge transfer from the universities to end users in field of environment have been assessed in this study. The findings offer valuable knowledge which helps to explore the impact of existing policies and for development of future planes with respect to make more effective role of universities in the knowledge creation and its transfer for development of society. Knowledge transfer practices have been arranged in seven clusters including publications, conferences, collaborations, intellectual property and so on to observe level of knowledge transfer by focusing on the academic field of environment. This research is one of the few exploratory studies to systematically consider on assessment of knowledge transfer practices from universities.

SIGNIFICANT STATEMENT

This study discovered the results of academic knowledge transfer practices in universities in field of environment, with some particular policy implications such as, to enhance the production of professional publication, improvement of

alumni organizations, industry people engagement in the academic events, enhancement of absorptive capacity of highly qualified graduates, structuring policies and infrastructure to support the commercialization of academic knowledge, favor of academic work in co-operation and development of mechanisms and infrastructure for development of university spin-offs and development of efficient TTOs.

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