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Do they perform what they perceive? Examining the IL skills of Pakistani Scientists

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by

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Abstract

This study aimed at assessing the difference between perceived and actual IL skills of scientists [research students]. In this descriptive correlational study, two scales were developed using ACRL standards for IL of science and engineering/ technology. A self-reporting scale for the evaluation of perceived IL skills and an MCQs-based tool for testing actual IL skills was administered concurrently among research students (M.Sc. MS/ M.Phil./ Ph.D.) of science disciplines of the University of Engineering and Technology (UET) Lahore and University of the Punjab (PU) Lahore. The findings revealed that the participants had overstated their perceived IL skills as they had showed poor performance in their test of actual IL skills. Thus, the results of paired sample t-test did not show calibration between perceived and actual IL skills of research students. The study had found the Dunning-Kruger effect on the perceived and actual IL skills of research students. The findings showed insignificant gender differences on perceived and actual IL skills of research students; however, the overestimation was found higher among females than their counterpart male research students regarding both IL skills. Similarly, PU's research students had performed better than UET's research students in test of actual IL skills. This is the first study that has tested actual IL skills of research students using an MCQ-based scale in Pakistan. The study has contextualized ACRL standards to identify overestimation between perceived and actual IL skills in science disciplines, i.e. a significant contribution in literature of information science. The outcomes of this study may help the library and information professionals, higher educational institutes, and related organizations to be engaged in teaching, designing and delivering IL instructions and programs. This study may also be helpful for academic researchers in articulating and contextualizing ACRL standards for the assessment of actual IL skills.

***Keywords*:** Information literacy (IL); Perceived IL skills; Actual (test) IL skills; Dunning-Kruger effect; Research students; Science disciplines

Introduction

Information literacy has emerged as ubiquitously essential good and recognized as an indispensable skill set for the 21st century particularly after invention and proliferation of information technology (Ameen & Gorman, 2009; Baro & Keboh, 2012). Contemporarily, the landscape of IL is expanded to every field of life especially it has become a critical part of students' lifelong learning. Pinto et al. (2010) demonstrate that "who wants to compete in this modern world of knowledge needs to know how to find analyze, evaluate and use information".

The overload of diverse and abundant information in unfiltered formats with its questionable authenticity, validity, and reliability, has posed challenges for research students to achieve their academic and research pursuits (Baro Emmanuel, 2011). Nonetheless, it is pertinent to note that information does not make students' information literate itself (Lau, 2006). Henceforth, to be a "critical consumer" of information (Ameen & Gorman, 2009), students require a special set of information literacy skills (Okiki & Mabawonku, 2013). Besides, a plethora of previous literature indicates that students particularly postgraduates far less prepared themselves with these important skills to prosper in this information society (Breivik, 2005; Hepworth & Duvigneau, 2012). Thus, the research students need critical, analytical and logical thinking skills to exploit literature effectively in their research projects (Aslam et al., 2005; Mahmood, 2013, 2017; Ullah & Ameen, 2014).

Despite an ample research is available on the evaluation of self-reported IL skills of postgraduate (research) students in Pakistan (Ahmad, 2014; Kousar & Mahmood, 2015; Mahmood, 2013; Naveed & Mahmood, 2019; Safdar & Idrees, 2020; Safdar & Idrees, 2021); however, summative [test/ actual] assessment of IL skills is neglected particularly among the scientists [research students] of science disciplines. Moreover, empirical literature is scant in local context to address the difference of perceived versus actual IL skills among scientists. Therefore, this study intends to bridge this gap in addition to provide practical as well as theoretical implications for universities, librarians, policy makers, and IL educators.

Research Objectives (RO) of the Study

RO-1: To evaluate perceived IL skills of research students (scientists) of science disciplines

RO-2: To assess the actual level of IL skills of scientists

RO-3: To find out the difference between perceived and actual IL skills of scientists

Literature Review

Generally, an extensive literature is available on IL which highlights the evolution of theoretical concept (Ameen & Ullah, 2016; Anwar & Naveed, 2019; Batool et al., 2021) and evaluation of IL skills among school, college and university students (Batool & Webber, 2014; Kousar & Mahmood, 2013; Naveed & Mahmood, 2019; Rafique & Mahmood, 2013; Rafique & Khan, 2018), medical students (Basit et al., 2021; Soroya et al., 2021), IL at workplace (Ali & Richardson, 2018; Naveed & Rafique, 2018), and professional groups (Batool & Webber, 2016; Khan et al., 2016; Naveed, 2021). Different studies have employed ALA/ACRL/STS Task Force on Information Literacy for Science and Technology (2021) as theoretical framework for designing instructional programs (Aydelott, 2007; Emmett & Emde, 2007; Kousar & Mahmood, 2013; Kousar & Mahmood, 2015; Rafique & Mahmood, 2013; Uribe-Tirado et al., 2017) using different methodologies. However, a limited research is available that have measured the assessment of information literacy skills of scientists (research students) of sciences disciplines. Moreover, the available literature could not adequately explain the differences between perceived and actual IL skills of research students or scientists of science disciplines.

Perceived IL Skills

Assessment methods have been popular in literature for evaluating the perceptions towards IL skills of different groups of individuals, students, professionals or others. The study of (Bundy, 1999, 2004) evaluated the IL skills of science students using Australian and New Zealand Information Literacy Framework (ANZIL). The results showed that students were found exceptional in some IL standards. Alike, Emmett and Emde (2007) carried out longitudinal study undertaking ACRL standards also revealed that graduate students of chemistry had better information literacy skills. Another study assessed the IL skills of students of basic sciences and indicated that these students had good ability of performing IL skills. However, an online IL assessment by Law et al. (2010) exhibited very low level of ILs among the students of science, math, etc. related to integrating, evaluating and communicating information.

So far as the local context is concerned, literature is scant exclusively evaluates the research students (RS) or postgraduate students (PGS) of science disciplines. Nonetheless, a small number of studies such as Kousar and Mahmood (2015) employed ACRL standards to explore faculty's perceptions towards the extent of IL skills of PGS in engineering disciplines at NUST university. However, the study indicated that faculty perceived disparity between the IL skills of PhD and MS students. Contrary to this, similar couple of studies based on

ACRL standards evaluated self-perceptions of researchers of PU and UET about IL skills. These study reported that PGS had adequate IL skills (Ahmad, 2014; Rafique & Mahmood, 2013).

A recent study by Basit et al. (2021) conducted among medical students also used ACRL standards to explore their perceptions about IL skills. This study found medical students with well-conversant IL skills in determining information need, evaluating information sources and understanding ethical and legal use of information. However, they were found week in using ICTs, formulating advance queries to locate digital information, citation management tools, information creation and presentation. However, a most recent of Safdar and Idrees (2021) evaluated and compared IL skills of undergraduate students (UGS) and PGS using survey method in addition to highlight the need of IL program. The study found the both groups of students non-conversant with IL skills which might impede their learning.

As regards as the international perspective, several studies highlighted the need and implication of information literacy in university and higher educational settings (Dadzie, 2007; Hosein, 2006; Jabeen et al., 2016). However, a handful studies assessed had explored IL competency of PGS of Haryana Agricultural University, India after developing a tool undertaking ACRL standards. The findings revealed PG students had satisfactory IL skills Singh and Joshi (2013). The study of Adeleke and Emeahara (2016) added that the PGS less exploited e-resources in their academic pursuits due to their poor IL skills. A couple of studies also indicated that research students had adequate skills for accessing and evaluating information sources on account of their information needs (Chanchinmawia & Verma, 2018); however, the female students were found more capable of designing keyword search strategy, information, citing sources and evaluating quality of information (Shettappanavar & Krishnamurthy, 2019).

Due to the primary foci of previous IL research reflected an increase in the volume of literature undertaking evaluation of self-perceptions of information users and their skills, attributes, and experiences. However, the empirical evaluation of self-reporting as well as assessment [test] IL skills is neglected particularly among the scientists (research student) of science disciplines in local context.

Actual IL skills

Due to an increasing impetus to include more overt teaching of information skills in postgraduate degree, the acquisition of IL skills was made integral part to be a professional scientist (Parker, 2003). Thus, different instruments were developed to test actual IL skills of

students in higher educational institutes in recent years. These instruments include James Madison University's IL Test, ETS iSkills Assessment Project SAILS, and so on. Although different instruments were developed to assess [test] IL competencies (i.e. actual skills) using ACRL IL standards (Neely, 2006); however, majority of these tools have not been validated.

Test instrument based on ACRL standards developed at James Madison University to measure four of the five IL competency standards (Cameron et al., 2007) through MCQ-based 60-items formulated by librarians and assessment specialists. All items comprised of multiple choice formats with alternative responses ranged from three to six (Swain et al., 2014). Another ACRL based information competency assessment project of Community Colleges consisted of two parts with 47 matching MCQ-based items and short answer followed by 12 performance based exercises (Ferguson et al., 2006). Later on, a dual-measure test based on ACRL standards was developed in Dakota State University to assess IL skills of the incoming students at university (Leibiger & Schweinle, 2008). Butler University was also developed a local instrument to test IL skills of incoming students (Helmke & Matthies, 2004). The test was consisted of 22 questions, 19 were relevant to check the skills and three were directed towards students' satisfaction.

Despite several IL standards and instruments were developed to test IL skills of students summatively. Literature provided little past evidences on the assessment [test] of IL skills (O'Connor et al., 2002) particularly among the scientists (research students) of science discplines. Maurer and Schloegl (2017) assessed students' IL skills using MCQ-based tool at University of Graz. The study revealed that students had poor level IL skills; however, they estimated their IL skills very high than their actual.

The aforesaid test-based studies are limited to reflect the application and implementation of formal assessment/test methodologies at a significant degree as well as show the extent in which students' actually meet these standards. Similarly, the aspect of assessing actual IL skills of scientists [postgraduate students] of sciences disciplines in literature was also neglected.

Difference between Perceived and Actual IL Skills

Furthermore, a small number of studies investigated the discrepancy between actual and perceived IL skills of students (Cameron et al., 2007; Geffert & Christensen, 1998; Ivanitskaya et al., 2004; Ren, 2000; Swain et al., 2014). Despite that this lean research focusing on the disparity between students' perceived and actual IL self-efficacy tended to be grounded in competency theory; which was endorsed by Kruger and Dunning (1999) in relation to metacognitive skills and competence. They suggested that individuals who held

low level of competence might lack the metacognitive skills to recognize their own inability. Thus, they could not perfectly judge their self or others' competencies and intended to overstate their skills (Kruger & Dunning, 1999).

Congruently, the study of Maughan (2001) observed that students at University of California-Berkeley overestimated their IL skills than actual IL skills. Similarly, another self-reported survey of students found overestimation regarding their skills of library use (Freeman, 2004). A comprehensive IL project was conducted at Quebec Universities using the ACRL standards among 5281 respondents. The findings indicated that a significant number of respondents had limited skills or no knowledge about the basic elements of information literacy (Mittermeyer, 2004). Information literacy task force of the University of Maryland, Baltimore developed an ACRL-based survey tool to measure the IL skills of incoming students of several departments particularly of biological sciences. The study reported a significant part of the respondents were found unaware and unfamiliar with the important concepts of IL such as searching techniques, identifying resources, copyrighted work, citation management (Ferguson et al., 2006). A systematic review by Mahmood (2016) investigated Dunning-Kruger Effect through the analysis of 53 studies undertaking assessment of self-reported and demonstrated IL skills of individuals. He concluded that people overestimated their perceived IL skills over their actual skills.

In spite of the fact that LIS literature could not provide adequate evidences on determining differences between actual and perceived IL skills of scientists [research students of science disciplines]. The findings of previously reviewed studies mirrored the Kruger and Dunning effect (Kruger & Dunning, 1999) as they have related it to information literacy.

Methodology

The present study is the part of Ph.D. research project used quantitative research based on survey method to explore discrepancies between perceived and actual IL skills of scientists. The population framework consisted of research students (scientists) from the University of Engineering and Technology (UET), Lahore and the University of the Punjab (PU), Lahore. The research students studying or enrolled in the postgraduate programs for M.Phil., MS/MSC, and PhD degree award in the pure/basic science disciplines of both universities were considered as "scientists" in this study. A non-random convenience sampling approach was used to approach the sample of the study. As the population has clear two subgroups (PU and UET), thus proportional stratified approach was employed to select the equal representation from the samples of both universities as presented in Table 1. Hence,

a sample size (n=296) was determined using sampling formula of (Adam, 2020) for survey research.

Table 1. *University wise population and sample size*

University	Population Size (N)	Proportion	Sample size (n)	Response rate
UET	275	24%	66	60(91%)
PU	1143	76%	230	215(93%)
Sample Size	1418	100%	296	275(93%)

IL Framework and Measurement Instruments

Information literacy in science, engineering, and technology disciplines is defined as "a set of abilities to identify the need for information, procure the information, evaluate the information and subsequently revise the strategy for obtaining the information, to use the information and to use it in an ethical and legal manner, and to engage in lifelong learning" (ACRL, 2006, 2021). Based on the ACRL IL competency standards for higher education, five standards and 25 performance indicators were developed related to Science and Engineering/ Technology disciplines. Each performance indicator is accompanied by one or more outcomes for assessing the progress toward IL of students of science and engineering/technology at all levels of higher education (ACRL, 2006, 2021).

After contextualizing the formerly available constructs and items on science and engineering/ technology related ACRL IL standards (ACRL, 2021) in literature, a structured questionnaire consisting of self-reporting scale (Ahmad, 2014; Mahmood, 2017; Rafique & Mahmood, 2013) as well as MCQs-based test tool (Cameron et al., 2007; Emmett & Emde, 2007; Ferguson et al., 2006; Pinto, 2010; Swain et al., 2014) was prepared to evaluate and assess scientists' IL skills. The segments and items of survey tool were finalized (Table 2) after incorporating the feedback acquired on account of seeking experts review from information management and science disciplines.

Table 2. *Segmentation of Data Collection Instrument*

Q.#	Key constructs	No. of items	Sca1e Used
1	Demographic variables (Gender, department, program)	3	Categorical
2	Academic Performance (CGPA)	1	Nominal
3	Publication(s)	1	Continuous
4	Perceived IL (Self-assessed) Skills	24	5-points Likert sca1e
5	Actual IL (Test) Skills	24	MCQs
	Total items	**53**	

The relevancy of items used in the questionnaire was ensured through experts review alongside conducting exploratory factor analysis (EFA) for structural validity (Sekaran & Bougie, 2016) undertaking Kaiser-Meyer-Olkin (KMO) for adequacy of sample i.e., reasonable as KMO = 0.876 (Kaiser, 1981) and principal component analysis (PCA) and Bartlett's sphericity test (p = 0.000) showing significant inter-correlation between items. The EFA conducted on 24 scaled items of perceived IL skills through PCA extraction method revealed a successful cross loading (ranging from 0.450 to 0.736) as presented in Table 2.

Table 3. *Exploratory Factor Analysis of PIL Skills Scale*

Items	ACRL Standards					Crone batch's α	
	Std-1	Std-2	Std-3	Std-4	Std-5	Segment-wise	Overall
PIL Standard-1							
PIL 1.1	.553						
PIL 1.2	.595					0.792	
PIL 1.3	.578						
PIL 1.4	.736						
PIL Standard-2							
PIL 2.1		.492			.		
PIL 2.2		.632					
PIL 2.3		.600				.740	
PIL 2.4		.666					
PIL 2.5		.612					
PIL Standard-3							
PIL 3.1			.610				
PIL 3.2			.522				
PIL 3.3			.477				0.909
PIL 3.4			.450			.706	
PIL 3.5			.707				
PIL 3.6			.721				
PIL 3.7			.628				
PIL Standard-1							
PIL 4.1				.725			
PIL 4.2				.643			
PIL 4.3				.544		.740	
PIL 4.4				.530			
PIL 4.5				.722			
PIL 4.6				.630			
PIL Standard-1							
PIL 5.1					.611	.501	
PIL 5.2					.554		

The results further showed that the latent variables were unidimensional and factorially distinct. Furthermore, Cronbach's alpha (CA) was carried out to verify the internal consistency of the constructs and items. The test determined acceptable scores (Taber, 2018)

for key segments (Standards) and overall as showed in Table 2. However, due to small number of items of PIL Standard-5, CA was determined less than accepted criterion. If number of items is increased, the score of Cronbach alpha may also be raised up.

Results and Discussion

Table 4 exhibited the demographic characteristics of participants of the study such as "gender, degree program and university name. The responses of the survey received from females n=149(54.2%) and males n=126(45.8%). Majority of the survey responses n=235(85.5%) were received from M.Phil. research students and n=40(14.5%) from PhD students studying in PU (n=215) and UET (n=60). A great majority of the research students (59.6%) had CGPAs ranging between 3.51 to 4.00. A very good number of research students had their CGPAs more than 3.00 which showed that research students had very good academic results.

Table 4. *Demographic Profile of the Respondents (N=275)*

Groups	Frequency	Percentage (%)
Gender		
Male	126	45.8%
Female	149	54.2%
Degree Program		
M.Phil.	235	85.5%
Ph.D.	40	14.5%
University		
University of the Punjab (PU)	215	78.18
University of Engineering & Technology (UET)	60	21.8

RO-1: Assessment of Perceived IL Skills of Scientists

Table 5 described a computational analysis for five IL competency standards used in this study for assessing perceived and actual IL skills. The results of perceived IL skills of students showed that the majority of the research students perceived that they could be able to define their information need (M=3.69, SD 0.98), identify potential information sources (M=3.36, SD 0.92), able to meet their information needs (M=3.68, SD 1.03), construct and implement search strategies (M=3.51, SD 0.98) effectively. While, the accumulative test score on standard one was 50.45 (M=2.52, SD 1.21) which was average.

The results of 2nd standards showed that majority of the research students perceived that they have the ability to identify potential sources of information (M=3.68, SD 1.03), and they were able to retrieve information using a variety of methods (M=3.39, SD 1.03).

Table 5. *Descriptive Results of Perceived and Actual ILS*

IL Standards	Perceived IL skills		Actual (Test) IL skills		
	M	SD	Correct Scores (%)	M	SD
Standard-1	3.40	0.75	50.45%	2.52	1.21
Standard-2	3.43	0.76	43.64%	2.18	1.17
Standard-3	3.62	0.69	38.34%	1.92	1.04
Standard-4	3.57	0.74	36.12%	1.81	0.97
Standard-5	3.56	0.89	39.09%	1.95	1.84
Overall	3.52	0.62	40.97%	2.05	0.68

Sca1e: 1= Strong1y Disagree (SD), 2=Disagree (D), 3=Neutral (N), 4=Agree (A), and 5=Strong1y Agree (SA)

Most of the research students perceived that they have the ability to examine and compare information gathered from various sources in order to evaluate their ability, validity and accuracy (M=3.77, SD 1.00). They could also summarize and extract main ideas (M=3.76, SD 0.96); construct new ideas (M=3.69, SD 1.01.

Most of the researchers were able "to understand ethical, legal and socio-economic issues of using information (M=3.78, SD 1.02). They were also able to follow laws, regulations, institutional policies, and etiquette related to the access and use of information resources (M=3.61, SD 1.01). They knew how to "cite the consulted information sources in appropriate manner (M=3.61, SD 1.01). The accumulative score on 4th standards were (M=3.57, SD= 0.74).

The perception on 5th revealed that majority of the participants were able "to communicate new product or performance effectively to others (M=3.61, SD 0.99). Moreover, the respondents could also be "able to use a variety of methods and emerging technologies for keeping update in the field" (M=3.53, SD 1.02) and life-long learning. The accumulative score on 5th standards were (M=3.56, SD= 0.89).

RO-2: Assessment of Actual (Test) IL Skills of Scientists

The test results of Table 5 exhibited that the respondents could not give 100% correct answers for each MCQ of five IL standards. The average results showed that nearly half of the respondents (n=49.5%) could reflect correct answers for the MCQs of Standard-1 (M=2.52, SD= 1.21). Similarly, the MCQs of Standard-2 were answered correctly only by 42.2% respondents (M=2.18, SD= 1.17). The MCQs of Standard-3 were answered correctly by 38.7% only (M=1.92, SD= 1.04). The MCQs of Standard-4 by 37.0%, (M=1.81, SD= 0.97) and the MCQs of Standard-5 by 39.2% were answered correctly (M=1.95, SD= 1.84) respectively. It could be concluded that the actual level of IL skills of research students was poor. Thus, the computed results of latent variables revealed that the majority of research

students had high perception towards their IL skills. On the other hand, the results showed that the research students had poor level of actual IL skills.

RO-3: Difference between Perceived and Actual IL Skills of Scientists

To test the hypothesis of *"there is no difference between perceived and actual skills of research students",* paired sample t-test was conducted to find out the mean difference in perceived and actual IL skills of research students.

Figure 1: Difference between Perceived and Actual IL Skills of Research Students

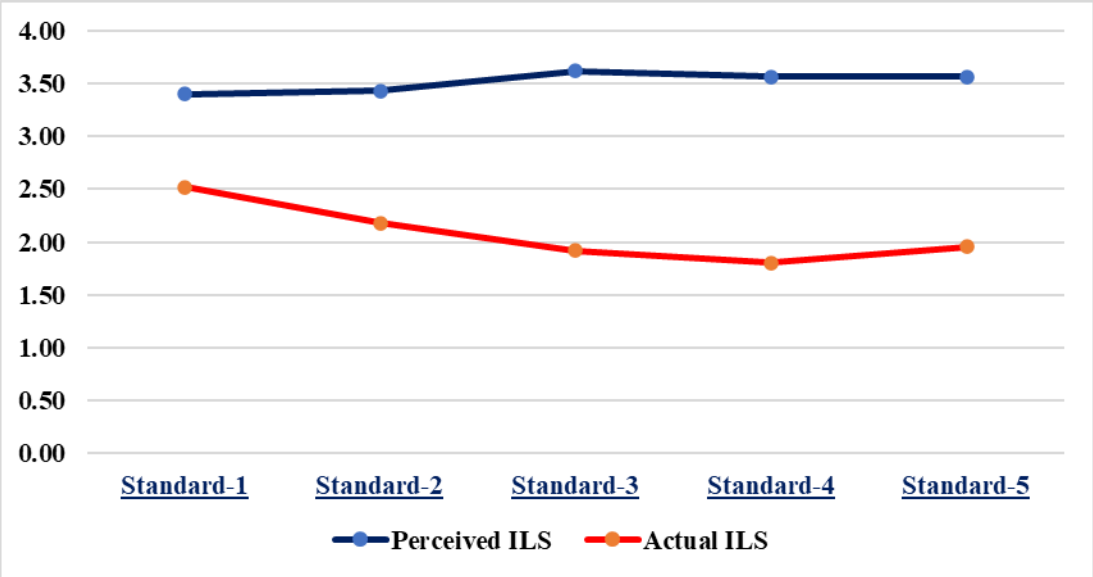

Table 6. *Difference between Perceived and Actual IL Skills of Research Students*

IL Standards	Pairs	M	SD	df	*t*	*p*
Standard-1	Perceived IL Skills	3.40	0.75	0.88	10.189	.000
	Actual IL Skill	2.52	1.21			
Standard-2	Perceived IL Skills	3.43	0.76	1.25	15.03	.000
	Actual IL Skills	2.18	1.17			
Standard-3	Perceived IL Skills	3.62	0.69	1.70	23.57	.000
	Actual IL Skills	1.92	1.04			
Standard-4	Perceived IL Skills	3.57	0.74	1.76	24.26	.000
	Actual IL Skills	1.81	0.97			
Standard-5	Perceived Il Skills	3.56	0.89	1.61	13.13	.000
	Actual IL Skills	1.95	1.84			
Overall	Perceived Il Skills	3.52	0.62	1.47	27.86	.000
	Actual IL Skills	2.05	0.68			

Sca1e: 1= Strong1y Disagree (SD), 2=Disagree (D), 3=Neutral (N), 4=Agree (A), and 5=Strong1y Agree (SA)

The results of Table 6 exhibited a statistically significant difference in scores of perceived IL skills (M=3.40, SD=0.75) and actual IL skills M=2.52, SD=1.21) for Standard-1; t(0.88) = 10.189, p = .000. Similarly, result showed a statistically significant difference in scores of perceived and actual IL skills for Standard-2 at t(1.25) = 15.03, p = .000; for Standard-3 at t(1.70) = 23.57, p = .000; for Standard-4 at t(1.76) = 24.26, p = .000 and for Standard-5 at t(1.47) = 27.86, p = .000. Additionally, the result of paired sample t-test also revealed a statistically significant difference in the scores of o*verall perceived IL Skills* (M=3.52, SD=0.62) and *overall actual IL skills* (M=2.05, SD=0.68) of all *Five IL Competency Standards at* t(1.47) = 27.86, p = 0.000.

The results suggested that the research students had inflated their perceived IL skills over their actual IL skills regarding all five IL competency standards. There was no calibration between perceived and actual IL skills of research students as displayed in Figure 1. Hence, the hypothesis, "*there is no difference between perceived and actual skills of research students*", was rejected.

Discussion

The purpose of this study was to identify discrepancy between the perceived and actual level of IL skills of scientists of two public sector universities. The findings of our study indicated that the scientists perceived themselves as *fairly high* information literate in defining their information needs, identifying potential information sources, retrieval techniques and judging the validity, reliability and accuracy of retrieved sources. They could better understand the ethical, legal and socio-economic issues of using information and citing consulted sources alongside keeping themselves updated.

Similarly, the findings of previous studies had supported that university postgraduate students were confident regarding their perceived IL skills (Ahmad, 2014; Bundy, 2004; Chanchinmawia & Verma, 2018; Emmett & Emde, 2007; Kousar & Mahmood, 2015; Rafique & Mahmood, 2013; Shettappanavar & Krishnamurthy, 2019; Singh & Joshi, 2013). Whereas, the results of a few past studies contradicted with the findings of current study (Adeleke & Emeahara, 2016; Law et al., 2010; Safdar & Idrees, 2021). Although a small number of research exhibited poor IL skills among university students; however, several indicated that PGS had exceptional in IL competencies.

The findings our study revealed that the scientists have poor level of actual IL skills as they could not totally pass the test of IL skills. The average scores of correct answers was achieved by scientists including 49.59% for the construct of "determining nature and extent of information needed"; 42.16% for "acquiring needed information effectively and

efficiently"; 38.64% for "critically evaluating information and its sources" 36.98% on "economic, ethical, legal, and social use of information and its technologies" and; 39.19% for understanding "IL is an ongoing process for lifelong learning". The study concludes that almost 59% research students demonstrating incorrect answers in test have very poor (zero) IL skills.

The findings of our study were also corroborated by prior research as a couple of studies by Krubu et al. (2017) and Maurer and Schloegl (2017) indicated that the students possessed very low level of actual IL skills; whereas, they and their teachers perceived them as excellent in IL skills. Another study by Santharooban (2016) reported a below average level of actual IL competency among students.

Our study concluded that the respondents had overestimated their perceived IL skills as the findings exhibited a statistically significant difference between the scores of perceived and actual IL skills of scientists. Our study indicated no calibration between their perceived and actual IL skills of scientists. The results showed that scientists had higher level of perceived IL skills than their actual (test) IL skills as they could not perform well in their test. Hence, the study confirmed that the scientists had overestimated their perceived IL skills over their actual level of IL skills.

The findings of our study suggested the Dunning-Kruger effect (Kruger & Dunning, 1999), where students would mis-calibrate their self-perceptions and actual metacognitive skills. The findings of our study were also similar to the results of the studies conducted by (Cameron et al., 2007; Ferguson et al., 2006; Freeman, 2004; Ivanitskaya et al., 2004; Maughan, 2001; Ren, 2000; Swain et al., 2014), where students had also rated their perceived IL skills higher than their actual IL skills. Moreover, a meta-analysis also reported no calibration between individuals' perceived and actual IL skills on account of overestimation in their self-assessments (Mahmood, 2016).

Limitations of the Study

There is a possibility in almost every research that it has some limitations in terms of research design, methodology, sampling technique, sample size, collection and analysis of data, response rate, etc. The study in hand, also have some limitations that should be taken into consideration while understanding its findings:

Students were not selected randomly but conveniently which might not be representable for whole population. A random sample would increase the likelihood of more generalizability for the study. The results of this study might be different while exploring the same phenomena by utilizing other research methodologies. As the sample was taken from

two public sector universities only, thus the small sample could compromise the generalizability of the results. The study of this phenomenon among research students on a large scale across all the universities and institutions in Pakistan might produce in-depth results.

Recommendation

The recommendations of our study indicate a need of inculcating an in-depth awareness about the importance of IL skills. For this purpose, library professionals should play a proactive role to highlight this phenomenon among various stakeholders such as students, faculty and management of educational institutes. Higher Education Commission (HEC) and Pakistan Council for Science and Technology (PCST), Pakistan Engineering Council (PEC), and Pakistan Science Foundation (PSF) as well as pertinent departments of universities can play a vital role in developing a specific policy or framework of IL which may be implemented in all higher educational institutions across the country.

Conclusion

The study concludes that the research students inflate their perceived IL skills over actual IL skills. Thus, this overestimation does not show calibration between their perceived and actual IL skills of scientists. The study supports the effect of Dunning and Kruger (1999) that individuals exaggerate their self-perceptions over actual capacity.

Implications of the Study

The present study has contributed some significant implications in terms of theory and practice. As regard as theoretical implications, the study has articulated the indicators of ACRL standards into local context to test the actual IL skills of science research students. Although numerous investigations have evaluated the perceived IL skill of students; however, there is a dearth of empirical evidences that test or assess the actual IL skills of research students in local context so far. The study has conceptualized intercorrelations between perceived and test IL skills. Additionally, a scale has been developed to test the actual IL skills of research students in the local context as well as to evaluate perceived IL skills which are statistically proved valid and reliable. Thus, the scale can be further adopted and tested in different contexts for contextualization purposes.

The study provides evidence that students are not that much information literate as they perceived themselves. The findings supported the Dunning-Kruger effect (Kruger & Dunning, 1999) as there was a weak (statistically insignificant) or no correlation between perceived and actual skills. Hence, future research can be conducted to develop best practices that can increase the abilities of IL among research students.

So far as the practical implications of this study are concerned, information skills are critically essential for students particularly postgraduate or research students. Hence, the academic faculty in general and the library professionals in particular should consider IL as important to be imparted the students. They should embed IL instructions and IL content in education, teachings and extend IL to the research students. The institutes of higher education make strategicall programs to improve the level of IL among students. The study may be helpful in articulating contextualizing ACRL standards in local context; eventually the students may perform better academically and socially.

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