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What are the Information Retrieval Skill Issues and What are the Attitudes Towards Information Literacy in Women Faculty of Engineering Colleges in West Tamil Nadu?

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Abstract

Context: In Western Tamil Nadu, 36% of all faculty in engineering colleges are women. These engineering colleges had contributed many engineers to the globalized corporate Information Technology (IT) industry. Women faculty using IT for teaching of Science, Engineering, Technology and Mathematics, (STEM) subjects, formed the social and technological context. *Aims:* The study framed 12 Null hypothesis (H_0) statements related to their opinion on information technology in their research and teaching: and 36 Null hypothesis (H_0) statements related to their self perception in specific information literacy (IL) skills. *Settings and Design:* The study methodology used a questionnaire instrument, to investigate attitudes towards Information Literacy (IL) and its use for classroom teaching and research. *Methods and Material:* The Cronbach alpha scores of the instrument, of five sections and 13 constructs, were moderately high. 41 engineering colleges affiliated to the Anna University, Chennai, located in nine Western Tamil Nadu districts, formed the study population. Of the 1476 women engineering faculty, 103 women responded. The study used the non-probabilistic "snowball" sampling methodology. *Results:* Women engineering faculty perceived themselves to have specific (IL) skills in information seeking, including the skills related to internet use. Their self perception regarding information retrieval skills (IRS) using printed sources, was positive. Their self-perception regarding IRS using internet sources was low. They found minimal benefits of changing information into action for research and classroom teaching. The reasons stated were lack of facilities and lack of orientation in pedagogy. *Conclusions:* Their self-confidence needs to be supplemented with skill building and incentivising the applying of IL/IRS skills to the classroom.

Keywords: Women in Stem; Tamil Nadu; Information Literacy; Information Retrieval; Women Engineering Faculty.

Introduction

Women in (STEM) — Science, Technology, Engineering and Mathematics:

"Gender Studies" have tracked significant under-representation of women in the "hard disciplines" of STEM.[1,2] This "social phenomena" has been observed across the world.[3] Since the 1990s, this "social phenomena" has been studied, to attempt "affirmative action" to increase the awareness and proportion of women in STEM.[4] The reasons for this

social phenomenon have been a subject of various theories. These include:

1. The "pipeline theory", which states that attrition increases at higher levels of education[5] — which is explained by income, class, and race variables: as relating to inadequate training in STEM subjects at school.
2. Gender bias, which plays out differently depending on a woman's race or ethnicity.[6]
3. Issues of self worth and efficacy.[7]
4. Social and environmental factors shaping girls' achievements and interest, the organisational climate of STEM departments in colleges and universities, of stereotyping and implicit bias.[8]
5. Women do not have an intrinsic aptitude for STEM.[9]

In the Indian context, gender studies have observed the fact of "feminist knowledge production", from the perspective of feminism, and transformation. (Sumi Krishna and Gita Chadha)[10,11]. Namrata Gupta (2007)[12] examined the nature of Indian womens' problems in the informal doctoral science environment in prestigious elite Indian Institutes of Technology (IITs). She found that the specific form of the biases and discrimination varied from that of the West, due to the cultural context. Deepamala (2019)[13,14] examined the opinion and attitudes of women faculty in engineering colleges, to use information technology in classroom teaching. Rega and Rani (2014) assessed gender differences in information literacy competency and found "men are more conversant in using technology to search for information then women".[15]

This particular empirical study attempted to ground these theories and studies around "Women in STEM": in the academic environment of women faculty in engineering colleges in Western Tamil Nadu. This empirical study researched the attitudes of women faculty in engineering, towards use of Information Technology (IT), Information Literacy skills (ILS) and Information Retrieval skills (IRS).

Women faculty in engineering colleges in Western Tamil Nadu and the Information Technology (IT) sector:

Anna University had 214 affiliated engineering colleges in western Tamil Nadu. These colleges employed around 22,000 faculty, of which women constituted 36%.

The corporate IT sector, centred around the South Indian cities of Bangalore, Chennai and Hyderabad, employed around 4.14 million engineers, in 2017. This sector reported export revenue of US$99 billion, and total revenues of US$160 billion in 2017[16]. The Ministry of Electronics and Information Technology, Government of India estimated the Compounded Annual Growth Rate (CAGR) for the five year period of 2013-2018 to be 9.55%[17]. The contribution of the IT sector to India's Gross Domestic Product (GDP) stood at 7.7 per cent in 2016[18].

Western Tamil Nadu engineering colleges placed many of its engineering graduates in this booming globalised corporate software/information technology sector. The issue of ILS and IRS of women engineering faculty, appear to increase in relevance: in this context of the job opportunities for their students in the IT sector.

Materials and Methods

Definitions

Association of College and Research Libraries (ACRL, 2000)[19] defined **"Information literacy"** to be *"a set of abilities requiring individuals to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information."* The American Library Association (ALA, 2013)[20] suggested Information Technology competency standards for higher education, for assessing the information literate student. This framework differentiated information technology (IT) skills from that of IL, stating. "*Information literacy... is an intellectual framework ... which may be accomplished ... by fluency with information technology, (and) by sound investigative methods, but most importantly, through critical discernment and reasoning. Information literacy initiates, sustains, and extends lifelong learning through abilities which may use technologies but are ultimately independent of them.*"[19]

The competencies presented a "continuum of expectations from the students" and presented a "process... which identifies a student as information literate". ALA suggested five graduated standards to assess the "information literate student": each with performance indicators and outcomes. These were —

- *Standard one:* Defining and articulating the need for information.
- *Standard two:* Accessing needed information effectively and efficiently.

- *Standard three:* Evaluating information and its sources critically and incorporating selected information into his/ her knowledge base and value system.
- *Standard four:* Using information effectively to accomplish a specific purpose (individually or as a group project).
- *Standard five:* Accessing and using information ethically and legally, after understanding the economic, legal, and social issues.

Instrument Design

The methodology used was that of a "statistical survey". The construction of the schedule/ instrument involved a literature review of 82 published papers and discussions with "information literacy" experts. The instrument consisted of five sections –

- Personal profile,
- Preferred information retrieval methods,
- Use of information technology in dissemination of knowledge,
- Self assessment of information literacy skills, and,
- Self confidence/attitude towards information literacy skills.

The instrument was built using thirteen constructs. The study used the Cronbach alpha (α) score to assess the internal consistency: which indicated a moderate to high degree of internal consistency. Table 1 gives the range of the Cronbach alpha (α) scores for the 13 constructs.

Table 1: Cronbach Alpha (α). for IR and ILS Instrument

Cronbach alpha (α). score range	Number of constructs
0.90-0.95	1
0.80-0.89	8
0.70-0.79	2
0.65-0.69	2
Total number of constructs	13

Abbreviations:

IR – Information Retrieval

ILS – Information Literacy Skills

Population and sampling

Forty-one engineering colleges, affiliated to Anna University, Chennai and located in the nine Western Tamil Nadu districts of Coimbatore, Dharmapuri, Erode, The Nilgiris, Karur, Thiruppur, Namakal, Krishnagiri and Salem, participated in the study. Of the estimated 1476 women engineering faculty in these 41 engineering colleges, 103 women (n=103) responded (7% of the sampling frame). The study coordinator contacted Principals/Directors of the engineering colleges, and their college librarians in the study area. Through their references, some women faculty came forward as respondents. Much of the data was collected online, through the internet, using the "Google Form" facility (which enables the respondent to directly respond on the internet to the questions in the schedule). Since this process involved some amount of referral, the method could be perhaps termed a sort of "snowball" sampling: which is a non-probabilistic method of sampling.

Respondents Profile

The respondent profile seemed to be concentrated in specific categories:

- The districts of Coimbatore and Erode had a disproportionate share (73%).
- The respondents were spread across 14 different engineering college departments: with two-thirds (67%) from departments directly linked to electronics and information technology.
- In terms of demographics: 66% of the respondents were between the ages of 23 to 30, and 70% had their social origins from non-urban habitats.
- In terms of education, 58% of the respondents had a postgraduate degree and, 28% were studying for a doctorate.
- In terms of position, 90% were assistant professors.
- 72% of the women engineering faculty had 2 to 10 years of work experience.

In terms of the critical variables of age, work experience and distribution of engineering colleges across districts, there appeared to be a higher degree of dispersion and skewness of the data. The following Table 2 gives some descriptive statistics of these three variables of the respondents. Figure 1 displays the graphs of the dispersion and skewness of the data.

Null hypothesis

The study framed Null hypothesis (H_0)

Table 2: Descriptive Statistics of the Respondents

Personal profile variable	Sample size	Mean	Median	Mode	Range	Standard Deviation	Coefficient of variation	Pearson's coefficient of skewness
Age (in years)	96	29.54	28	24,25,26 (three modes)	23 to 49	5.49	18.58%	0.84
Engineering colleges in a district (number)	103	11.44	3	2	2 to 56	17.08	149%	0.55
Work experience (in years)	103	4.53	3.64	2.93	0 to 20	0.69	15.23%	2.39

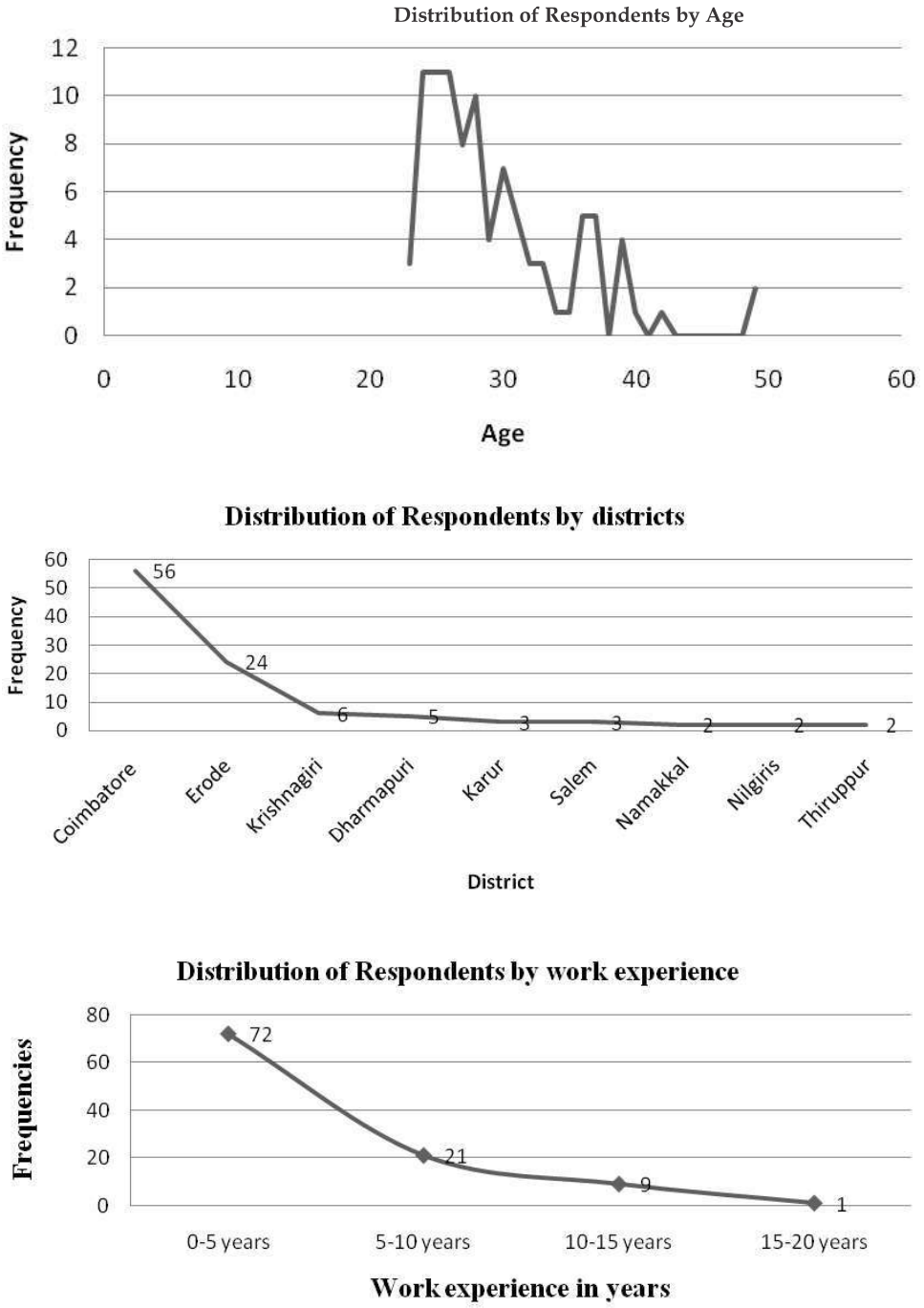

Fig. 1: Frequency Distribution of Personal Profile Variables

statements to analyse the collected data, to infer results. Twelve Null hypothesis (H_0) statements were related to the opinion of women engineering faculty in using information technology in their research and teaching.

Thirty-six Null hypothesis (H_0) statements were related to their self-perception in specific information literacy skills.

Results

Attitudes

In terms of specific Information Literacy (IL) skills in information seeking, the respondents, women engineering faculty, seemed to perceive that they had the skills related to question formation, brainstorming, categorising, skimming, scanning, evaluating printed material, content analysis, note making, synthesising, and information presentation of findings. The respondents perceived themselves to be having the skills related to internet use – in terms of using internet search engines, data bases, and evaluating online material.

In terms of Information Retrieval Skills (IRS) using printed sources, women engineering faculty perceived that they have the skills related to area scanning, subject searching in bibliographies, abstracting and indexing, author searching and cross checking. The respondents did NOT perceive themselves to have the skills of footnote chasing, citation searching, and journal content analysis.

In general, women engineering faculty did NOT perceive themselves to having the skills of Information Retrieval skills (IRS) using the internet. Specifically, they perceived themselves to NOT have the skills of skimming, bouncing, berry picking, chaining, and squirreling.

In terms of the self confidence of use of information literacy skills, the respondents perceived themselves to be capable in evaluating the quality of information retrieved and to use electronic formats, like online catalogues. In terms of opinions and attitudes, the respondents seemed to have in general, a good self-assessment of their information literacy skills.

A simple ranking exercise for preferred choice of technology seemed to indicate multimedia to be the overwhelming first choice for use in classroom, followed by the internet, and finally using printed sources.

Analysis of Ethics and Attitudes – using the Chi square (χ^2) Goodness of Fit Test[21]:

The chi square (χ^2) test for goodness of fit is a non-parametric test, and lends itself for sampled data, where no assumptions can be made for the form of the original distribution of the underlying population. Statistically, it is a special case of the gamma distribution. It is usually characterized by a single parameter, the number of degrees of freedom (υ). The chi square (χ^2) probability density function (pdf) is generated for continuous data: and is constructed so that the total area under the curve is equal to 1. The pdf is given by[22] —

$$f(\chi^2) = (C) * (\chi^2)^{(\upsilon/2 - 1)} * e^{(-\chi^2/2)}$$

Where:

υ = number of degrees of freedom,

C = Constant depending on the degrees of freedom,

e = a constant equal to the base of the natural logarithm system =2.71828, and

*= the elementary arithmetic operation of Multiplication

The area under the curve between 0 and a particular positive chi-square value is a cumulative probability associated with that chi-square value. When this value is the p- (or alpha –α) value, it differentiates between the acceptance region of the null hypothesis and the rejection region. When expressed as a percentage it is the level of significance. Figure two is a graphical is a graphical representation of the chi square (χ^2) distribution.

In a goodness of fit test, the fit between a theoretical distribution and the observed distribution, is tested at a particular level of significance, for rejection of the null hypothesis. The null hypothesis is that there is a fit between the observed distribution and the theoretical distribution. If the chi squared value lies within the acceptance region, the null hypothesis is NOT rejected. If the chi squared value lies to the right of the - p- (or –α) value, data could indicate that the null hypothesis may not be accepted.

The goodness of fit was tested against an assumption that the observations, to multiple-choice questions on ethics and attitudes towards IL and IRS, followed a "uniform distribution". If the analysis seemed to show sufficient cause to not accept the null hypothesis: this implied that the respondents preferred some responses over others. The alpha –α (or "p" value) was set at 0.005 and at 0.010 (that is a probability of 99.5% and 99%). Table 3 displays the results of the chi square analysis —

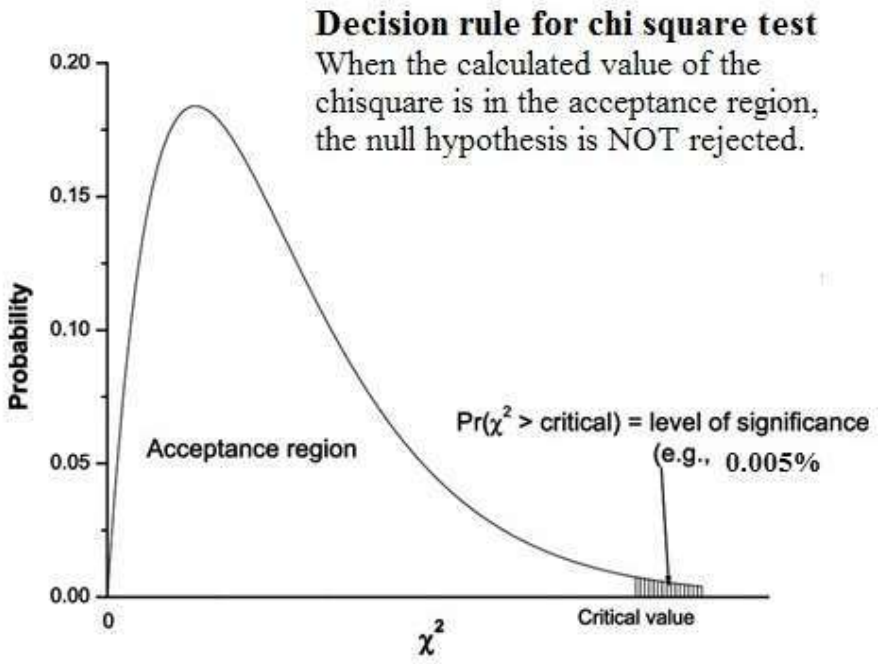

Fig. 2: The Chi Square (χ^2) Distribution

Table 3: Chi Square Analysis on Ethics and Attitudes Towards IL & IRS

Null Hypothesis	Responses (n)	Degrees of freedom (v)	Calculated (χ2)	Level of significance (α)	Table value of (χ2)	Result
All the responses on the ethics of copying text from a source without considering the copyright law are uniformly distributed	86	3	12.82	0.010	11.345	Not accept H_0
All the responses on the ethics of inclusion of citations in research papers are uniformly distributed	95	4	18.10	0.005	14.86	Not accept H_0
All the responses on the expectations of results from enhancing teaching skills through research and innovative thinking are uniformly distributed	84	3	12.85	0.005	12.84	Not accept H_0
All the responses regarding the effect of enhanced information literacy (IL) skills and information retrieval strategies (IRS) are uniformly distributed	93	3	38.99	0.005	12.84	Not accept H_0
All the responses on the effectiveness of various methods of classroom dissemination of research information to students are uniformly distributed	97	3	17.45	0.005	12.84	Not accept H_0

Abbreviations:

IL– Information Literacy

IRS – Information Retrieval Skills

CHI Square Analysis on Ethics and Attitudes Towards ILS & IRS

The following conclusions can possibly be derived from the chi-squared analysis regarding the perceptions on ethics and attitudes of the respondents towards ILS and IRS:

1. Copying text from a source without considering copyright law was plagiarism and a copyright violation.
2. Enabling location of sources, giving credit to authors, determining source credibility, and avoiding plagiarism were the reasons for the

ethical standard of inclusion of citations in research papers.

3. Enhancing teaching skills, through research and innovative thinking had definite results in terms of focussing higher education for development of the society and for focussing career development.
4. Acquiring Information Literacy Skills (ILS) and in Information Retrieval Strategies (IRS) created a positive impact, in terms of creating excellence in teaching, research, and personal development, as also positively influenced (classroom) teaching methodology.
5. Directing interested students to refer research reports and guiding simple experiments with simplified reporting of results were the best methods of classroom dissemination of research information.

Practise – Converting IL and IRS to action in the engineering classroom teaching and research

The respondents found minimal benefits of changing information into action in terms of research and classroom teaching, and little benefits from using acquired information for research and teaching. They did not see a need to change teaching practice due to information, because they felt that teaching as per syllabus reference material was enough. They felt there was little orientation in pedagogical issues. The women faculty named lack of facilities as one of the reasons, of not being able to process information into action in terms of research and teaching. They however felt they had sufficient time to make changes to teaching practice, when they acquired new information.

Discussion and Conclusion

The world of Information Technology is a quick changing one. Gordon Moore (1965) [22] had estimated an annual doubling in the number of components per integrated circuit, a trend which seems to have continued down the decades (popularly known as Moore's law). These information technological innovations have had far reaching consequences on increasing productivity, economic growth and changing society. An example can be that of analogue technology of storage of images in plastic films or voice in magnetic tapes: which have given way to storage of voice or image data using digital technology. In practical terms, it can sometimes mean that by the time an engineering graduate enters the job market, the technology skills s/he learnt in their graduate program, can sometimes become obsolescent. Examples from information technology could be the shift from dedicated physical hardware server technology to virtual servers in a cloud-computing environment, which can be accessed remotely via the internet. To complicate matters, these changes can mean changes in software, to accommodate new devices for user access — like Android for mobile phones. "Disruptive technologies" such as cloud, social media and data sciences termed SMAC (Social, mobility, analytics, cloud) are expected to drive further technological innovation to create economic growth, and improve standards of living. Hence, there is pressure on the engineering college faculty to embark on a mission of lifelong learning, to equip their students to face the very fast changing world of technology, markets, and society.

Eminent technology leaders have expressed lack of confidence in the quality of engineering education in India. Narayanamurthy, (2011)[24] the founder of Infosys, has voiced concern over the quality of engineering graduates, stating that these graduates fare poorly at jobs and in global institutions of higher education. E. Sreedharan, (2016)[25] the "Indian railway metro train man", stated "Engineering colleges ... are producing very sub-standard quality of engineers." Referring to a survey of 300 engineering colleges, he concluded that only 29% engineers are employable, while 30% can be made employable after further studies, whereas 48% are simply not employable.

Women faculty in engineering colleges in Western Tamil Nadu by virtue of their numbers and their young age have a key role to play to ensure that the classroom education stays relevant to the changing trends. These women seemed to have a high level of self-confidence towards acquiring and use of information literacy and retrieval skills. However there appears to exist some mental barriers in these women faculty, and perhaps also in the larger engineering college academic culture, towards using these skills for classroom teaching and research. Further skill training in information literacy using internet sources seems to be required for women engineering faculty in Western Tamil Nadu. These need to be supplemented with attitudinal and orientation courses, in using the skills gained, directly for research and classroom training. The larger organisational culture of "learning" in these engineering colleges, perhaps needs to be changed for incentivising use of information technology based on information literacy and information retrieval skills, in classroom teaching and in applied

research, by women engineering faculty in Western Tamil Nadu.

Key Messages:

Women teaching faculty of engineering in Western Tamil Nadu, have a high level of self -confidence in their information literacy skills. They need skill training for information retrieval using the internet. The academic culture needs to incentivise the use of these skills for classroom teaching and research.

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Conflicting Interest: Nil

Abbreviations

ACRL - Association of College and Research Libraries

ALA - American Library Association

CAGR - Compounded Annual Growth Rate

CV - Coefficient of Variation

IIT - Indian Institute of Technology

IT - Information Technology

IL - Information Literacy

ILS - Information Literacy Skills

IRS - Information Retrieval Skills

SMAC - Social, Mobility, Analytics, Cloud

STEM - Science, Engineering, Technology and Mathematics

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