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# Examining Relationship between Pre-service Teachers' Self-reported and Computed Technology Expertise

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**Abstract:**

*The present study investigated the relationship between the self-reported and computed expertise of the pre-service teachers in using technology available at their institutions and software applications for academic and personal activities. The study was conducted in the context of two variables: gender and stream of study. A sample of 150 pre-service teachers was drawn from the teacher education institutions of Patna University and Magadh University of Bihar, India by multi-stage cluster sampling technique. The results emphasized across gender difference in self-reported and computed expertise in software applications for academic activities and across stream difference in using technology available at the institutions and software applications for academic activities. However no significant difference was observed in the pre-service teachers' expertise in software applications for personal activities.*

**Key words**: Technology expertise, Pre-service teachers, Gender, Stream of study

## Introduction

Technology expertise of pre-service teachers refers to their efficacious use of diverse technology for curricular transactions, interaction with their teachers and peer-group, preparation and presentation of assignments, project reports and assessment and for keeping themselves connected with the informal virtual

and social spaces to learn the latest and enrich their learning experiences. They recognize the technological applications and scope in education to the varying degree of their expertise. According to Kumar (2012), there are people who understand a lot of technology and people who understand a lot of academics; but there are few people who understand both of these things. Such people can effect a merger between technology and academics. In the present study, technology expertise of the pre-service teachers has been operationally defined in terms of being novice (able to perform basic technological applications), competent (demonstrate a general competency in a number of technological applications) and proficient ((have expertise in a number of different technological applications). The geographical coverage of the study was Patna, the capital city of Bihar, India. Bihar is a developing state of India; however as per the compilation of University Grants Commission (UGC), New Delhi, based on the deliberations of the Working Group for Higher Education (Twelfth Five Year Plan, 2012-17), Bihar has low Higher Education Institutional density (7.2 HEIs/1000 sq. km.) as well as low Gross Enrolment Ratio (11%). Technology can play a significant role in dissemination of knowledge to dispersed population. However, there is a dearth of technology usage in Higher Education Institutions of Bihar. The leading teacher education institutions of the state have taken an initiative in this regard and started making use of technological innovations in the pedagogical practices. To effectively implement technology in the teaching-learning process, it is important that the in-service and pre-service teachers perceive their ability to use technology in different subject areas. It is crucial to study teachers' self perception about technology as it is an important determinant in future technological uses. The present study has been delimited to the technology expertise of the pre-service teachers.

In this context, the following research questions were investigated:

1. What are the levels of self-reported and computed technology expertise of the pre-service teachers?
2. How are the self-reported and computed technology expertise of the pre-service teachers associated across gender and stream of study?

## Literature Review:

If the pre-service teachers have the know-how of using technology in academics, they should be aware of their expertise, accept it with confidence and it must reflect in their pedagogical practices. The use of technology by the prospective teachers is linked to their self-efficacy beliefs. Self-efficacy can be described as belief in one's ability to perform a particular behaviour. Bandura introduced the concept of self-efficacy or "beliefs in one's capacity to organize and execute the courses of action required to produce given attainments" (Bandura 1997, 3). If the pre-service teachers are and also perceive themselves as effective technology users, they can incorporate different hardware and software applications in instructional practices, become knowledge creators and instill the same in their students when they join schools as full time teachers on graduating. Compeau and Higgins (1995) found that participants with higher self-efficacy beliefs use technology more often and experience less technology-related anxiety. Further, Molebash (2004) argued that the perception of pre-service teachers regarding technology influences their decisions related to integration of technology into specific subjects while teaching. It is important for the pre-service teachers to understand the exact level of the technological skills possessed by them to use them effectively and shift from traditional to more constructivist instruction. Studies in different countries have shown that pre-service teachers vary in their self efficacy

beliefs regarding teaching. (Tercanlioglu 2001). Research on the efficacy of the teachers suggests the teachers who are more efficacious exhibit behaviours such as persistence at a task, risk taking and the use of innovations (Ashton & Webb 1986). With the increased practical affordance of technology, technology-mediated pre-service teacher education has gained importance.

Studies on gender based differences in technology efficacy of pre-service teachers are diverse. However, the findings are contradictory. As per the study conducted by Raudenbush, Rowan and Cheong (1992), females have higher teaching efficacy than males. However, when it comes to ICT competence, Rekabdarkolaei and Amuei (as cited in Alaba 2010, 58) revealed that female teachers are more anxious or less experienced and less confident. Hence there is a need to enhance the female teacher trainees' self-concept and self-efficacy in ICT so that they can have the confidence to develop the required skills to help them become ICT facilitators when they get to the field (Adodo 2012). Loyd & Gressard (as cited in Busch 1995, 2) reported that female students have less computer anxiety than the male students and they like working with computers more than the male students. Studying gender issues in ICT literacy and online training, Markauskaite (2006) found a significant gender gap in confidence about their technical ICT capabilities. Female students have been observed to possess less positive perceptions of their computer competence (Busch 1995); Males have reported to have more ability with computes and are more attracted to computers than their females counterparts (Nelson & Cooper 1997). In a study conducted on Chinese teacher candidates from four Normal Universities of China, Sang et al (2009) concluded that gender of student teachers did not have a direct effect on their prospective ICT integration. Shapka and Ferrari (2003) did not observe any gender gap in computer attitude or outcomes in computer-related tasks in teacher candidates of Canada. Thus, we see that some studies contend that males are more confident

in technology usage and have more positive perception about their technology efficacy; there are still other studies that do not show any significant finding. A lot depends on the exposure of the two to the technology-enabled environment. In recent times, when technology has become an integral part of the institutions of learning, this gap is gradually decreasing. In this context, Kirkpatrick and Cuban (as cited in Wong et al. 2005, 63) argued that gender gap is narrowed when the same type of exposure to computer-related works is provided. Hanafi et al. (as cited in Wong et al. 2005, 63) also noted the absence of gender disparity when females and males carry out their learning endeavours in similar kind of technology-rich learning environment.

No significant literature could be found on the relation between the stream of study and the perceived technology expertise of the prospective teachers.

## Method:

### Research Design

Descriptive survey design was used to collect data from a selected sample of pre-service teachers with respect to the various variables taken in the study.

### Variables

There were two independent variables in the study: gender and stream of study of the pre-service teachers. The study explored the association between the self reported and computed technology expertise of the pre-service teachers with respect to these two variables. Technology expertise was studied in terms of the pre-service teachers' use of technology available at their institution, their software applications for academic activities and their software applications for personal activities.

## Apparatus

The researcher developed a questionnaire to seek answers to the questions related to demographic variables and technology expertise of the pre-service teachers. Before framing the questionnaire, she made a survey of the various technologies available to the teacher trainees in their educational institutions and also of the software applications being used for curricular transactions. The instructional practices adopted by teacher educators, the learner and learning support services available to the pre-service teachers for their academic and professional growth were studied. Special effort was made to find out the technological pre-requisites of the course, the competency of the teacher educators in using technology and the opportunities available to the pre-service teachers (in terms of hours per day) at their institutions to use various technological applications for learning, completion of assignments and projects, peer teaching and other academic endeavours. Information related to additional training and add-on courses offered to them was also obtained. Thus, on the basis of observation, study of available documents and interviews of teacher educators, the questionnaire was developed. It had two types of questions; one that required self-reporting on the part of the pre-service teachers on the basis their perception and the other that required statistical analysis of their responses to various questions, to validate the first part. To the first part, the teacher candidates self-reported their technology expertise. The corresponding second part sought their responses on a 3-point scale to calculate their expertise in using technology available at their educational institutions, software expertise for academic uses and software expertise for personal uses. Cronbach alpha reliability coefficients calculated to measure the inter-item consistency of each part ranged from 0.73-0.93.

## Sampling and Data Collection

Multistage cluster sampling technique was used to draw a sample of 150 pre-service teachers studying one year B.Ed. programme in two universities of Patna; Patna University and Magadh University. Prior to the collection of data, permission was taken from the Heads of the institutions. A copy of the number of students enrolled in Sciences, Mathematics, Computer Science, Social Sciences, Humanities, Arts and Commerce was obtained from the concerned institutions to select a representative sample. Since the pre-service teachers in these universities have to select two teaching methods from the subjects mentioned above strictly as per the prescribed curriculum, a number of students were common learners of some of the subjects. As such the researcher merged the subjects to form three distinct stream of study, viz., Science and Mathematics (also comprising students of Computer Science), Arts (also comprising students of Social Sciences and Humanities) and Commerce. Then depending upon the number of students in these streams, a representative sample was drawn. After that the questionnaire was administered on the selected sample to collect data.

| | **Females** | | | **Males** | | | **Total** |
|---|---|---|---|---|---|---|---|
| | ≤ 25 yrs | 26yrs -35 yrs | 36 yrs -45 yrs | ≤ 25 yrs | 26yrs -35 yrs | 36 yrs -45 yrs | |
| Science and Maths | 14 (15.6%) | 12 (13.4%) | 4 (4.4%) | 10 (16.7%) | 5 (8.3%) | 2 (3.3%) | 47 (31.3%) |
| Arts | 25 (27.8%) | 10 (11.1%) | 3 (3.3%) | 19 (31.7%) | 8 (13.3%) | 2 (3.3%) | 67 (44.7%) |
| Commerce | 10 (11.1%) | 9 (10%) | 3 (3.3%) | 7 (11.7%) | 4 (6.7%) | 3 (5%) | 36 (24%) |
| **Total** | **90 (60%)** | | | **60 (40 %)** | | | **150** |

**Table 1 Sample characteristics**

Table 1 shows that in the sample, there were 60% females and 40% males; 31% Science and Mathematics students, 45% Arts students and 24% Commerce students. It is

also seen that the maximum number of pre-service teachers belonged to the age group of 25 years or less (around 55% females and 60% males) and the least number belonged to the age group of 36 years-45 years (around 11% females and 12% males). So the pre-service teachers selected formed a young sample.

## Results and Discussion:

After collection, data was tabulated in Microsoft Excel worksheet and the datasheet of Statistical Package for Social Sciences (SPSS), Version 16.0. Statistical analysis included simple descriptives to inferential statistical technique like Chi square ($\chi^2$).

### *Research Question One*

*What are the levels of self-reported and computed technology expertise of the pre-service teachers?*

| **Self-reported technology expertise** | | **Computed technology expertise** | | | **Total** |
|---|---|---|---|---|---|
| | | Novice | Competent | Proficient | |
| Novice | Count | 4 | 47 | 2 | 53 |
| | % within Self-reported | 7.5% | 88.7% | 3.8% | 100.0% |
| | % within Computed | 50.0% | 38.5% | 10.0% | 35.3% |
| | % of Total | 2.7% | 31.3% | 1.3% | 35.3% |
| Competent | Count | 3 | 54 | 10 | 67 |
| | % within Self-reported | 4.5% | 80.6% | 14.9% | 100.0% |
| | % within Computed | 37.5% | 44.3% | 50.0% | 44.7% |
| | % of Total | 2.0% | 36.0% | 6.7% | 44.7% |
| Proficient | Count | 1 | 21 | 8 | 30 |
| | % within Self-reported | 3.3% | 70.0% | 26.7% | 100.0% |
| | % within Computed | 12.5% | 17.2% | 40.0% | 20.0% |
| | % of Total | 0.7% | 14.0% | 5.3% | 20.0% |
| Total | | 8 | 122 | 20 | **150** |
| % of Total | | 5.3% | 81.3% | 13.3% | |

**Table 2 - Self-reported technology expertise*Computed technology expertise**

Table 2 indicates that 35% of the pre-service teachers reported themselves to be novices, 45% competent and 20% proficient in technology usage. Their technology expertise as computed on the basis of their responses shows that 81% of them were actually competent and only 5% were novice. This discrepancy suggests that the pre-service teachers have low self efficacy or belief in their capability to use technology effectively. According to Olivier & Shapiro (1993) the individuals who perceive themselves as ineffective technology users reject technology use in future. So, the low self efficacy of the pre-service teachers may affect their future technological applications for instructional interventions. The observed difference between the self-reported and computed technological expertise may have underlying factors in form of gender, stream of study and age.

### *Research Question Two*

*How are the self-reported and computed technology expertise of the pre-service teachers associated across gender and stream of study?*

The following null hypotheses were framed:

$H_{01}$ Self-reported and computed technology expertise of the pre-service teachers are not significantly associated across gender.

$H_{02}$ Self-reported and computed technology expertise of the pre-service teachers are not significantly associated across the stream of study.

The significance of association was analysed using $\chi^2$ test of independence.

### *Null Hypothesis* $H_{01}$ *related to Research Question Two*

*Self-reported and computed technology expertise of the pre-service teachers are not significantly associated across gender.*

The technology expertise of the pre-service teachers was studies in terms of their use of technology available at their institution; and their software applications for academic and personal activities (Keengwe 2007).

$H_{01}$ can be derived from the following sub-hypotheses:

$H_{01.1}$ Self-reported and computed expertise of the pre-service teachers in using technology available at their institution are not significantly associated across gender.

$H_{01.2}$ Self-reported and computed expertise of the pre-service teachers in software applications for academic activities are not significantly associated across gender.

$H_{01.3}$ Self-reported and computed expertise of the pre-service teachers in software applications for personal activities are not significantly associated across gender.

### *Sub-hypothesis* $H_{01.1}$

*Self-reported and computed expertise of the pre-service teachers in using technology available at their institution are not significantly associated across gender.*

Among the participants, 37% females reported themselves to be novices, 50% to be competent and 13% proficient in using technology available at their institutions. However, it emerged from computation that 47% of the female participants were competent in using technology available while 20% and 33% were novices and proficient respectively. For male participants, 33%, 37% and 30% reported themselves to be novices, competent and proficient in using technology

available at their institutions, while the corresponding computed expertise was 30%, 38% and 32% respectively. Table 3 presents a detailed account of the reported and computed technology expertise of the pre-service teachers.

| **Gender** | **Self-reported expertise** | | **Computed expertise** | | | |
|---|---|---|---|---|---|---|
| | | | Novice | Competent | Proficient | Total |
| Females | Novice | Count | 10 | 18 | 5 | 33 |
| | | Expected Count | 6.6 | 15.4 | 11.0 | 33.0 |
| | | % of Total | 11.1% | 20.0% | 5.6% | 36.7% |
| | Competent | Count | 7 | 21 | 17 | 45 |
| | | Expected Count | 9.0 | 21.0 | 15.0 | 45.0 |
| | | % of Total | 7.8% | 23.3% | 18.9% | 50.0% |
| | Proficient | Count | 1 | 3 | 8 | 12 |
| | | Expected Count | 2.4 | 5.6 | 4.0 | 12.0 |
| | | % of Total | 1.1% | 3.3% | 8.9% | 13.3% |
| | | Total | 18 | 42 | 30 | **90** |
| | | % of Total | 20.0% | 46.7% | 33.3% | |
| Males | Novice | Count | 6 | 9 | 5 | 20 |
| | | Expected Count | 6.0 | 7.7 | 6.3 | 20.0 |
| | | % of Total | 10.0% | 15.0% | 8.3% | 33.3% |
| | Competent | Count | 7 | 8 | 7 | 22 |
| | | Expected Count | 6.6 | 8.4 | 7.0 | 22.0 |
| | | % of Total | 11.7% | 13.3% | 11.7% | 36.7% |
| | Proficient | Count | 5 | 6 | 7 | 18 |
| | | Expected Count | 5.4 | 6.9 | 5.7 | 18.0 |
| | | % of Total | 8.3% | 10.0% | 11.7% | 30.0% |
| | | Total | 18 | 23 | 19 | **60** |
| | | % of Total | 30.0% | 38.3% | 31.7% | |

**Table 3 Self-reported *Computed expertise in using technology available**

To test whether the self-reported and computed technology expertise were significantly associated across gender ($H_{01.1}$), Chi-square test of independence was performed. The results have been summarized in Table 4.

| Gender | | Value | df | Asymp. Sig. (2-tailed) | Approx. Sig |
|---|---|---|---|---|---|
| Female | Pearson Chi-Square | 8.668 | 4 | 0.070 | - |
| | N of Valid Cases | 90 | - | - | - |
| | Phi | 0.310 | - | - | 0.070 |
| | Cramer's V | 0.219 | - | - | 0.070 |
| Male | Pearson Chi-Square | 5.546 | 4 | 0.236 | 0.236 |
| | N of Valid Cases | 60 | - | - | - |
| | Phi | 0.304 | - | - | 0.236 |
| | Cramer's V | 0.215 | - | - | 0.236 |

**Table 4 Chi-square test**
**p > 0.05 level of significance**

The table depicts that there is no significant association between the reported and computed technology expertise of the female and male pre-service teachers. This means that the self-reported and computed expertise of using the technology available at the institution are independent of each other across gender. Both the female and male pre-service teachers are hesitant in expressing or are not sure of the level of their technology expertise. This reflects the low level of technology usage in curricular practices of their institutions which does not provide sufficient opportunity to the prospective teachers to comprehend their competency of handing the available technological equipments and applications. All these indicate towards the low self efficacy of the pre-service teachers in using the available technology for instructional purposes. More in depth studies are required to substantiate this contention as the teachers' perceived ability to use technology affects their technology use in future (Zhao & Cziko as cited in Teo & Koh, 2010, 7) and self efficacy beliefs of the pre-service teachers influence their behavioural intentions to use technology (Teo 2009).

### *Sub-hypothesis $H_{01.2}$*

*Self-reported and computed expertise of the pre-service teachers in software applications for academic activities are not significantly associated across gender.*

The reported and computed expertise of the female and male participants in computer software applications for academic activities have been presented in Table 5. It is seen that 27% of the female participants reported to be novices while the computed value was 20%, 52% reported to be competent while 50% was the computed value and 21% reported to be proficient while the computed value was 30%. Of the male participants, about 34% reported that they were novices in software applications, 43% stated that they were competent and 23% reported that they were proficient in software applications for academic activities. Again, a difference was observed in the self-reported and computed technology expertise of the pre-service teachers.

| Gender | Self-reported expertise | | Computed expertise | | | |
|---|---|---|---|---|---|---|
| | | | Novice | Competent | Proficient | Total |
| Females | Novice | Count | 9 | 8 | 7 | 24 |
| | | Expected Count | 4.8 | 12.0 | 7.2 | 24.0 |
| | | % of Total | 10.0% | 8.9% | 7.8% | 26.7% |
| | Competent | Count | 3 | 32 | 12 | 47 |
| | | Expected Count | 9.4 | 23.5 | 14.1 | 47.0 |
| | | % of Total | 3.3% | 35.6% | 13.3% | 52.2% |
| | Proficient | Count | 6 | 5 | 8 | 19 |
| | | Expected Count | 3.8 | 9.5 | 5.7 | 19.0 |
| | | % of Total | 6.7% | 5.6% | 8.9% | 21.1% |
| | | Total | 18 | 45 | 27 | **90** |
| | | % of Total | 20.0% | 50.0% | 30.0% | |
| Males | Novice | Count | 7 | 11 | 2 | 20 |
| | | Expected Count | 6.0 | 8.3 | 5.7 | 20.0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | % of Total | 11.7% | 18.3% | 3.3% | 33.3% |
| | Competent | Count | 8 | 11 | 7 | 26 |
| | | Expected Count | 7.8 | 10.8 | 7.4 | 26.0 |
| | | % of Total | 13.3% | 18.3% | 11.7% | 43.3% |
| | Proficient | Count | 3 | 3 | 8 | 14 |
| | | Expected Count | 4.2 | 5.8 | 4.0 | 14.0 |
| | | % of Total | 5.0% | 5.0% | 13.3% | 23.3% |
| | | Total | 18 | 25 | 17 | **60** |
| | | % of Total | 30.0% | 41.7% | 28.3% | |

**Table 5 Self-reported*Computed expertise in academic software applications**

To find out the significance of association between the self-reported and computed expertise of the pre-service teachers in software applications for academic activities ($H_{01.2}$), Chi-square test of independence was done.

| Gender | | Value | df | Asymp. Sig. (2-tailed) | Approx. Sig |
|---|---|---|---|---|---|
| Female | Pearson Chi-Square | 14.055[a] | 4 | 0.007 | - |
| | N of Valid Cases | 90 | - | - | - |
| | Phi | 0.395 | - | 0.007 | 0.007 |
| | Cramer's V | 0.279 | - | 0.007 | 0.007 |
| Male | Pearson Chi-Square | 1.528[b] | 4 | 0.822 | - |
| | N of Valid Cases | 60 | - | - | - |
| | Phi | 0.160 | - | 0.822 | 0.822 |
| | Cramer's V | 0.113 | - | 0.822 | 0.822 |

**Table 6 Chi-square test**

*$p^a < 0.05$ level of significance, $p^b > 0.05$ level of significance

The table clearly shows significant association between the self-reported and computed expertise in software applications for the female pre-service teachers, however, the Phi and Cramer's V values show that the association is weak. No significant association is seen for the male pre-service teachers. Thus for the males, self-reported and computed expertise of software applications for academic activities are

independent of each other. This suggests that irrespective of the actual software use for academic endeavours, female pre-service teachers have a slightly better perception about their ability to use technology for academic activities than their male counterparts. This contradicts a number of previous studies (Rekabdarkolaei & Amuei 2008; Namlu & Ceyhan 2002; Nelson & Cooper 1997; Busch 1995).

### *Sub-hypothesis $H_{01.3}$*

*Self-reported and computed expertise of the pre-service teachers in software applications for personal activities are not significantly associated across gender.*

An overview of the expertise of the female pre-service teachers in software applications for personal activities shows 29%, 34% and 37% as reported novices, competent and proficient technology users; and 19%, 53% and 28% as computed novices, competent and proficient technology users. In case of male pre-service teachers, an overview of the expertise shows 27%, 46% and 27% as reported novices, competent and proficient technology users and 12%, 65% and 23% as computed novices, competent and proficient technology users. The result has been tabulated in Table 7.

| Gender | Self-reported expertise | | Computed expertise | | | |
|---|---|---|---|---|---|---|
| | | | Novice | Competent | Proficient | Total |
| Females | Novice | Count | 9 | 13 | 4 | 26 |
| | | Expected Count | 4.9 | 13.9 | 7.2 | 26.0 |
| | | % of Total | 10.0% | 14.4% | 4.4% | 28.9% |
| | Competent | Count | 1 | 24 | 6 | 31 |
| | | Expected Count | 5.9 | 16.5 | 8.6 | 31.0 |
| | | % of Total | 1.1% | 26.7% | 6.7% | 34.4% |
| | Proficient | Count | 7 | 11 | 15 | 33 |
| | | Expected Count | 6.2 | 17.6 | 9.2 | 33.0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | % of Total | 7.8% | 12.2% | 16.7% | 36.7% |
| | | Total | 17 | 48 | 25 | **90** |
| | | % of Total | 18.9% | 53.3% | 27.8% | |
| Males | Novice | Count | 3 | 12 | 1 | 16 |
| | | Expected Count | 1.9 | 10.4 | 3.7 | 16.0 |
| | | % of Total | 5.0% | 20.0% | 1.7% | 26.7% |
| | Competent | Count | 1 | 25 | 2 | 28 |
| | | Expected Count | 3.3 | 18.2 | 6.5 | 28.0 |
| | | % of Total | 1.7% | 41.7% | 3.3% | 46.7% |
| | Proficient | Count | 3 | 2 | 11 | 16 |
| | | Expected Count | 1.9 | 10.4 | 3.7 | 16.0 |
| | | % of Total | 5.0% | 3.3% | 18.3% | 26.7% |
| | | Total | 7 | 39 | 14 | **60** |
| | | % of Total | 11.7% | 65.0% | 23.3% | |

**Table 7 Self-reported*Computed expertise in personal software applications**

The significance of association between the self-reported and computed expertise in software applications for personal activities of the pre-service teachers across gender ($H_{01.3}$) was put to test using Chi-square test of independence as shown in Table 8.

| Gender | | Value | df | Asymp. Sig. (2-sided) | Approx. Sig. |
|---|---|---|---|---|---|
| Female | Pearson Chi-Square | 19.368[a] | 4 | 0.001 | - |
| | N of Valid Cases | 90 | - | - | - |
| | Phi | 0.464 | - | - | 0.001 |
| | Cramer's V | 0.328 | - | - | 0.001 |
| Male | Pearson Chi-Square | 31.811[b] | 4 | 0.000 | - |
| | N of Valid Cases | 60 | - | - | - |
| | Phi | 0.728 | - | - | 0.000 |
| | Cramer's V | 0.515 | - | - | 0.000 |

**Table 8 Chi-square test**
***p[a] < 0.05 level of significance, *p[b] <0.05 level of significance**

In both the female and male pre-service teachers there is a significant association between the self-reported and

computed expertise in software applications for personal activities. This association is strong for males but moderate for the females included in the study, as revealed by the Phi and Cramer's V values.

It can be interpreted that gender does not affect the self efficacy beliefs of the pre-service teachers in using software applications for personal activities. This is in line with previous researches (Wong & Hanafi 2007; Shaw & Gant 2002; Mehloff 2001). The probable reason may be that though technology is not been used to the level that it should be used for academic activities, both the male and female pre-service teachers are using it abundantly for personal activities. As such both of them are confident and are able to accurately report their expertise in software applications when asked. This is supported by the past studies that argue that as technology has become a part and parcel of our lives, it has ceased to be dominated by males (King, Bond, & Blandford 2002; North & Noyes 2002). Theories from psychology and sociology that suggest that gender disparity in computer competence and use exists due to stereotyped roles ascribed to males and females (Aremu, as cited in Aremu 2011, 180) also provide stance to the finding of the researcher.

### *Null Hypothesis* $H_{02}$ *related to Research Question Two*

*Self-reported and computed technology expertise of the pre-service teachers are not significantly associated across the stream of study.*

Just as the study of technology expertise across gender, here also the technology expertise of the pre-service teachers has been studied in terms of their use of technology available at their institutions; and their computer software applications for academic and personal activities.

Hence, the following sub-hypotheses emerge from $H_{02}$:

$H_{02.1}$ Self-reported and computed expertise of the pre-service teachers in using technology available at their institutions are not significantly associated across the stream of study.

$H_{02.2}$ Self-reported and computed expertise of the pre-service teachers in software applications for academic activities are not significantly associated across the stream of study.

$H_{02.3}$ Self-reported and computed expertise of the pre-service teachers in software applications for personal activities are not significantly associated across the stream of study.

Stream of study refers to the pre-service teachers studying Science and Mathematics, Arts and Commerce as their teaching methods.

### *Sub-hypothesis $H_{02.1}$*

*Self-reported and computed expertise of the pre-service teachers in using technology available at their institutions are not significantly associated across the stream of study.*

The self reported expertise of the pre-service teachers studying Science and Mathematics in using technology available at their institutions for academic purposes showed 58% competent and 21% novice and proficient users. Their computed expertise showed 40% competent, 23% novice and 36% proficient pre-service teachers. Among the Arts and Commerce pre-service teachers, about 40% reported to be novice and competent users and 20% reported to be proficient in using technology available at their institutions. Computation of their expertise revealed 21% and 31% novice, 46% and 42% competent, and 33% and 28% proficient pre-service teachers of Arts and Commerce streams respectively. This observation has been presented in table 9.

| Stream | Self-reported expertise | | Computed expertise | | | |
|---|---|---|---|---|---|---|
| | | | Novice | Competent | Proficient | Total |
| Science and Mathematics | Novice | Count | 2 | 8 | 0 | 10 |
| | | Expected Count | 2.3 | 4.0 | 3.6 | 10.0 |
| | | % of Total | 4.3% | 17.0% | .0% | 21.3% |
| | Competent | Count | 9 | 9 | 9 | 27 |
| | | Expected Count | 6.3 | 10.9 | 9.8 | 27.0 |
| | | % of Total | 19.1% | 19.1% | 19.1% | 57.4% |
| | Proficient | Count | 0 | 2 | 8 | 10 |
| | | Expected Count | 2.3 | 4.0 | 3.6 | 10.0 |
| | | % of Total | .0% | 4.3% | 17.0% | 21.3% |
| | | Total | 11 | 19 | 17 | **47** |
| | | % of Total | 23.4% | 40.4% | 36.2% | |
| Arts | Novice | Count | 7 | 12 | 8 | 27 |
| | | Expected Count | 5.6 | 12.5 | 8.9 | 27.0 |
| | | % of Total | 10.4% | 17.9% | 11.9% | 40.3% |
| | Competent | Count | 3 | 15 | 8 | 26 |
| | | Expected Count | 5.4 | 12.0 | 8.5 | 26.0 |
| | | % of Total | 4.5% | 22.4% | 11.9% | 38.8% |
| | Proficient | Count | 4 | 4 | 6 | 14 |
| | | Expected Count | 2.9 | 6.5 | 4.6 | 14.0 |
| | | % of Total | 6.0% | 6.0% | 9.0% | 20.9% |
| | | Total | 14 | 31 | 22 | **67** |
| | | % of Total | 20.9% | 46.3% | 32.8% | |
| Commerce | Novice | Count | 7 | 7 | 2 | 16 |
| | | Expected Count | 4.9 | 6.7 | 4.4 | 16.0 |
| | | % of Total | 19.4% | 19.4% | 5.6% | 44.4% |
| | Competent | Count | 2 | 5 | 7 | 14 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Expected Count | 4.3 | 5.8 | 3.9 | 14.0 |
| | | % of Total | 5.6% | 13.9% | 19.4% | 38.9% |
| | Proficient | Count | 2 | 3 | 1 | 6 |
| | | Expected Count | 1.8 | 2.5 | 1.7 | 6.0 |
| | | % of Total | 5.6% | 8.3% | 2.8% | 16.7% |
| | | Total | 11 | 15 | 10 | **36** |
| | | % of Total | 30.6% | 41.6% | 27.8% | |

**Table 9 Self-reported*Computed expertise in using technology available**

To test the null hypothesis ($H_{02.1}$), Chi-square test of independence was employed. The results have been tabulated in Table 10 given below.

| Stream | | Value | df | Asymp.Sig. (2-sided) | Approx. Sig. |
|---|---|---|---|---|---|
| Science and Mathematics | Pearson Chi-Square | 17.758[a] | 4 | 0.001 | - |
| | N of Valid Cases | 47 | - | - | - |
| | Phi | 0.615 | - | - | 0.001 |
| | Cramer's V | 0.435 | - | - | 0.001 |
| Arts | Pearson Chi-Square | 4.058[b] | 4 | 0.398 | - |
| | N of Valid Cases | 67 | - | - | - |
| | Phi | 0.246 | - | - | 0.398 |
| | Cramer's V | 0.174 | - | - | 0.398 |
| Commerce | Pearson Chi-Square | 6.475[c] | 4 | 0.166 | - |
| | N of Valid Cases | 36 | - | - | - |
| | Phi | 0.424 | - | - | 0.166 |
| | Cramer's V | 0.300 | - | - | 0.166 |

**Table 10 Chi-square test**

*$p^a < 0.05$ level of significance, $p^b > 0.05$ level of significance, $p^c > 0.05$ level of significance

According to the results displayed in the above table, there is a significant association between the self-reported and computed expertise in using the technology available at their institutions for the pre-service teachers studying Science and

Mathematics. For the pre-service teachers studying Arts and Commerce, no significant association is observed. Thus, only for the pre-service teachers of Science and Mathematics, the self reported expertise and the computed expertise in using technology available at their institutions are associated. On the basis of Phi and Cramer's V values, it can be interpreted that this association is moderate. For the pre-service teachers studying Arts and Commerce, the self-reported and computed expertise are independent of each other.

The above observation suggests that the pre-service teachers studying Science and Mathematics are more aware of their capabilities of using technology and are also using them. However, in Arts and Commerce, there is still a need to increase the use of technology available at the institutions. The use of technology by teachers can be linked to teachers' self-efficacy beliefs. In this context, Compeau and Higgins (as cited in Hakverdi et al. 2007) noted that 'individuals with higher self-efficacy beliefs with regard to computers see themselves as able to use computer technology, regardless of how difficult or challenging the task is. On the other hand, individuals with lower self-efficacy beliefs about computers become more frustrated and more anxious working with computers and hesitate to use them when they encounter obstacles.'

### *Sub-hypothesis $H_{02.2}$*

*Self-reported and computed expertise of the pre-service teachers in software applications for academic activities are not significantly associated across the stream of study.*

Table 11 shows that 30% of the Science and Mathematics pre-service teachers reported themselves to be novice, 55% to be competent and 15% to be proficient in software applications for academic activities. On computation it emerged that 21% were novice, 47% were competent and 32%

were proficient. For pre-service teachers opting Arts, the self reported expertise in software applications for academic activities showed 33% novices, 42% competent and 25% proficient, while the computed values were 33% novices, 39% competent and 28% proficient users. Self reported expertise of Commerce pre-service teachers was 22% novices, 53% competent and 25% proficient in software applications for academic activities, and computed expertise revealed 11% novices, 61% competent and 28% proficient users.

| Stream | Self-reported expertise | | Computed expertise | | | |
|---|---|---|---|---|---|---|
| | | | Novice | Competent | Proficient | Total |
| Science and Mathematics | Novice | Count | 6 | 5 | 3 | 14 |
| | | Expected Count | 3.0 | 6.6 | 4.5 | 14.0 |
| | | % of Total | 12.8% | 10.6% | 6.4% | 29.8% |
| | Competent | Count | 2 | 16 | 8 | 26 |
| | | Expected Count | 5.5 | 12.2 | 8.3 | 26.0 |
| | | % of Total | 4.3% | 34.0% | 17.0% | 55.3% |
| | Proficient | Count | 2 | 1 | 4 | 7 |
| | | Expected Count | 1.5 | 3.3 | 2.2 | 7.0 |
| | | % of Total | 4.3% | 2.1% | 8.5% | 14.9% |
| | | Total | 10 | 22 | 15 | **47** |
| | | % of Total | 21.3% | 46.8% | 31.9% | |
| Arts | Novice | Count | 10 | 7 | 5 | 22 |
| | | Expected Count | 7.2 | 8.5 | 6.2 | 22.0 |
| | | % of Total | 14.9% | 10.4% | 7.5% | 32.8% |
| | Competent | Count | 5 | 18 | 5 | 28 |
| | | Expected Count | 9.2 | 10.9 | 7.9 | 28.0 |
| | | % of Total | 7.5% | 26.9% | 7.5% | 41.8% |
| | Proficient | Count | 7 | 1 | 9 | 17 |
| | | Expected Count | 5.6 | 6.6 | 4.8 | 17.0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | % of Total | 10.4% | 1.5% | 13.4% | 25.4% |
| | | Total | 22 | 26 | 19 | **67** |
| | | % of Total | 32.8% | 38.8% | 28.4% | |
| Commerce | Novice | Count | 0 | 7 | 1 | 8 |
| | | Expected Count | .9 | 4.9 | 2.2 | 8.0 |
| | | % of Total | .0% | 19.4% | 2.8% | 22.2% |
| | Competent | Count | 4 | 9 | 6 | 19 |
| | | Expected Count | 2.1 | 11.6 | 5.3 | 19.0 |
| | | % of Total | 11.1% | 25.0% | 16.7% | 52.8% |
| | Proficient | Count | 0 | 6 | 3 | 9 |
| | | Expected Count | 1.0 | 5.5 | 2.5 | 9.0 |
| | | % of Total | .0% | 16.7% | 8.3% | 25.0% |
| | | Total | 4 | 22 | 10 | **36** |
| | | % of Total | 11.1% | 61.1% | 27.8% | |

**Table 11 Self-reported*Computed expertise in academic software application**

To test the significance of association between the self-reported and computed expertise of the pre-service teachers in software applications for academic activities across stream of study, Chi-square test of independence was performed. The results have been presented in Table 12.

| Stream | | Value | df | Asymp. Sig. (2-sided) | Approx. Sig. |
|---|---|---|---|---|---|
| Science and Mathematics | Pearson Chi-Square | 10.539[a] | 4 | 0.032 | - |
| | N of Valid Cases | 47 | - | - | - |
| | Phi | 0.474 | - | - | 0.032 |
| | Cramer's V | 0.335 | - | - | 0.032 |
| Arts | Pearson Chi-Square | 18.008[b] | 4 | 0.001 | - |
| | N of Valid Cases | 67 | - | - | - |
| | Phi | 0.518 | - | - | 0.001 |
| | Cramer's V | 0.367 | - | - | 0.001 |
| Commerce | Pearson Chi-Square | 5.994[c] | 4 | 0.200 | - |
| | N of Valid Cases | 36 | - | - | - |

| | | | | | |
|---|---|---|---|---|---|
| | Phi | 0.408 | - | - | 0.200 |
| | Cramer's V | 0.289 | - | - | 0.200 |

**Table 12 Chi-square test**

***p$^a$ < 0.05 level of significance, *p$^b$ < 0.05 level of significance, p$^c$ > 0.05 level of significance**

The values of $\chi^2$ are significant for Science, Mathematics and Arts students and not significant for Commerce students. This means that in Science, Mathematics and Arts, there is an association of self-reported and computed expertise of the pre-service teachers in software applications for academic activities; Phi and Cramer's V show moderate association between the variables. The two variables are independent of each other for Commerce students. Strong association between the variables suggests that the pre-service teachers are aware of their technology competency and have high self efficacy beliefs.

There is a mutual relationship between the self efficacy beliefs and technology usage. Higher the self efficacy beliefs regarding technology usage in academic activities, more is the technology use done by the teachers and more use of technology with positive experiences further increases the self efficacy of the learners. This appears to be the reason for the difference observed in the above analysis. Science and Mathematics students have stronger beliefs about their technology competency because of their frequent use of technology for instructional purposes, assignments, projects and other classroom related activities. The positive association between the self reported and computed expertise of software applications for academic activities of Arts pre-service teachers may be attributed to their high self efficacy or the fact that student teachers of a number of subjects such as History, Political Science, Economics, Geography, Home Science, Hindi and English have been clubbed together due to their overlapping in teaching methods offered by the institutions from which the sample was drawn. More studies are required in this context.

### *Sub-hypothesis $H_{02.3}$*

*Self-reported and computed expertise of the pre-service teachers in software applications for personal activities are not significantly associated across the stream of study.*

More than 50% percent of the Science and Mathematics teacher-trainees reported themselves to be competent in software applications for personal activities. About 25% reported themselves to be novices and about 23% reported themselves to be proficient users. Their computed expertise revealed more than 60% as competent, less than 15% as novices and about 25% as proficient in software applications for personal activities. Among the Arts and Commerce pre-service teachers, 32% - 36% reported themselves to be competent, about 27% and 33% respectively to be novices and about 40% and 30% respectively to be proficient users. Computation of their expertise showed that more than 50% of the Arts and Commerce pre-service teacher were competent, 16% and 20% of them were novices and 30% and 20% of them respectively were proficient users of software applications for personal activities. Table 13 produces the details of the analysis.

| Stream | Self-reported expertise | | Computed expertise | | | |
|---|---|---|---|---|---|---|
| | | | Novice | Competent | Proficient | Total |
| Science and Mathematics | Novice | Count | 4 | 7 | 1 | 12 |
| | | Expected Count | 1.5 | 7.4 | 3.1 | 12.0 |
| | | % of Total | 8.5% | 14.9% | 2.1% | 25.5% |
| | Competent | Count | 0 | 20 | 4 | 24 |
| | | Expected Count | 3.1 | 14.8 | 6.1 | 24.0 |
| | | % of Total | .0% | 42.6% | 8.5% | 51.1% |
| | Proficient | Count | 2 | 2 | 7 | 11 |
| | | Expected Count | 1.4 | 6.8 | 2.8 | 11.0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | % of Total | 4.3% | 4.3% | 14.9% | 23.4% |
| | | Total | 6 | 29 | 12 | 47 |
| | | % of Total | 12.8% | 61.7% | 25.5% | |
| Arts | Novice | Count | 3 | 12 | 3 | 18 |
| | | Expected Count | 3.0 | 9.7 | 5.4 | 18.0 |
| | | % of Total | 4.5% | 17.9% | 4.5% | 26.9% |
| | Competent | Count | 2 | 16 | 4 | 22 |
| | | Expected Count | 3.6 | 11.8 | 6.6 | 22.0 |
| | | % of Total | 3.0% | 23.9% | 6.0% | 32.8% |
| | Proficient | Count | 6 | 8 | 13 | 27 |
| | | Expected Count | 4.4 | 14.5 | 8.1 | 27.0 |
| | | % of Total | 9.0% | 11.9% | 19.4% | 40.3% |
| | | Total | 11 | 36 | 20 | 67 |
| | | % of Total | 16.4% | 53.7% | 29.9% | |
| Commerce | Novice | Count | 5 | 6 | 1 | 12 |
| | | Expected Count | 2.3 | 7.3 | 2.3 | 12.0 |
| | | % of Total | 13.9% | 16.7% | 2.8% | 33.3% |
| | Competent | Count | 0 | 13 | 0 | 13 |
| | | Expected Count | 2.5 | 7.9 | 2.5 | 13.0 |
| | | % of Total | .0% | 36.1% | .0% | 36.1% |
| | Proficient | Count | 2 | 3 | 6 | 11 |
| | | Expected Count | 2.1 | 6.7 | 2.1 | 11.0 |
| | | % of Total | 5.6% | 8.3% | 16.7% | 30.6% |
| | | Total | 7 | 22 | 7 | 36 |
| | | % of Total | 19.4% | 61.1% | 19.4% | |

**Table 13 Self-reported*Computed expertise in personal software applications**

Table 14 presents the results of testing the null hypothesis ($H_{02.3}$) using Chi-square test of independence. It is seen that the pre-service teachers' self reported and computed expertise of software application for personal activities of the

pre-service teachers across the stream of study are significantly associated and are not independent. Hence the null hypothesis is rejected.

| Stream | | Value | df | Asymp. Sig (2-sided) | Approx. Sig. |
|---|---|---|---|---|---|
| Science and Mathematics | Pearson Chi-Square | 20.896[a] | 4 | 0.000 | - |
| | N of Valid Cases | 47 | - | - | - |
| | Phi | 0.667 | - | - | 0.000 |
| | Cramer's V | 0.471 | - | - | 0.000 |
| Arts | Pearson Chi-Square | 11.311[b] | 4 | 0.023 | - |
| | N of Valid Cases | 67 | - | - | - |
| | Phi | 0.411 | - | - | 0.023 |
| | Cramer's V | 0.291 | - | - | 0.023 |
| Commerce | Pearson Chi-Square | 21.365[c] | 4 | 0.000 | - |
| | N of Valid Cases | 36 | - | - | - |
| | Phi | 0.770 | - | - | 0.000 |
| | Cramer's V | 0.545 | - | - | 0.000 |

**Table 14 Chi-square test**
***p[a] < 0.05 level of significance, *p[b] < 0.05 level of significance, *p[c] < 0.05 level of significance**

The Phi and Cramer's V values show a moderate to high relationship between the pre-service teachers' self reported and computed expertise in using software applications for personal activities. This suggests that the pre-service teachers are aware of their capabilities of software applications for their personal activities. Irrespective of their stream of study, they are using software for their personal use and this has given them the confidence to understand their expertise in the same. It also suggests a high self efficacy belief of the teacher trainees in software applications and implies that if for academic activities also, their use is increased; the pre-service teachers will become more confident and develop high efficacy beliefs irrespective of their gender and stream of study.

## Conclusion

Technology expertise of pre-service teachers plays a significant role in deciding their use of hardware and software technologies for academic, professional and personal activities. Their awareness of the level of their technology expertise is even more important. The belief in one's ability to use technology curbs the hesitation in its actual use and promotes its successful integration in the pedagogical practices, in the light of the available resources. On the basis of a research conducted on relationship between computer efficacy beliefs and individual's decision to use them, Hill, Smith, & Mann (1987) argued that the self efficacy beliefs regarding computers influence an individual's decision to use them.

The absence of significant association between the self-reported and computed expertise of the male and female pre-service teachers in using the technology available at their institutions implies that the pre-service teachers are not being provided sufficient opportunity to use technology for their teaching-learning endeavours, due to which they are not able to assess their actual level of technology expertise. When the male and female pre-service teachers are exposed to the same kind of technology-rich environment, they perceive similar self efficacy beliefs regarding the use of technology.

The difference between the self-reported and computed technology expertise of the pre-service teachers pursuing different stream of study is obvious in those streams where technology is not being used to the required levels for curricular transactions.

Thus, in modern times, when the pre-service teachers are competent in using technology for personal activities, their institutions of learning should provide them space, time and resources to use technology for their academic and professional growth.

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