# Subject-Self Affecting on Teachers' Perceived ICT Usability:
## A Proposition for TAM3+

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## ABSTRACT

This study reports an empirical investigation of the effects of school teachers' self-efficacy and self-concept on their perceived ICT usability. It employed a descriptive survey method within an ex-post-facto research design taking 300 teachers as samples from 50 Indian schools. The findings revealed that self-efficacy and self-concept discretely had a positive effect on teachers' perceived ICT usability although self-concept was found to have a deeper impact in comparison to self-efficacy. But the two variables operated simultaneously had a more significant and stronger positive effect on the teachers' perceived ICT usability. For every 1 standard unit increase in self-efficacy and in self-concept, the perceived ICT usability will be increased by 0.95 standard units. Based on this regression output, the authors proposed the TAM3+ as an extension of the TAM3 by adding a new domain as users' 'subjective self' encompassing self-efficacy and self-concept significantly affecting their perceived ease of technology use.

## KEYWORDS

ICT, Perceived Usability, School Teachers, Self-Concept, Self-Efficacy, TAM3+

## INTRODUCTION

The great philosopher, poet, and the Noble laureate Kabiguru Rabindranath Tagore once wrote "amari chetonar ronge panna holo sobuj, chuni hoye uthlo ranga hoye" (Tagoreweb, n.d.) and this Bengali line implies the significance of 'ami' or 'human self' in this universe. The existence of this universe is relative of and dependent to this human psychological self. Similarly, William James, a philosopher, a leading thinker of the late 19th century, and the 'Father of American psychology' has also observed that there is but one cause of human failure and that is man's lack of faith in his true self (William James Quotes, n.d.). Self-belief and self-concept holistically named as 'subjective-self' by Gergely (2007) that is subjective sense of affective self-experience which is inevitable to succeed in any domain of human life at any developmental stage. Rasman (2018) depicts and points out the

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strong relationship between self-system and human motivational currents. This self-system is equally effective during technology adoption for information and communication technology (ICT) based teaching-learning. ICT, a ubiquitous aspect of modern human life, plagued with the latest developments relating to 'reification' and 'ephemeralization' has proved its immense potential in delivering education effectively, especially in the post COVID-19 pandemic affected world when its urgency is being felt more than ever across the globe every hour by every teacher (Kundu & Bej, 2021). In this context, the implication of Technology Acceptance Model (TAM), originally developed by Fred Davis in 1986 is beyond question (Davis, 1989). It shows technology adoption does not merely depend on the available resources and infrastructure rather a large extent of it is dependent on users' behavioral intention, perceived usefulness, and ease of use or usability. Few more factors have been added in the latest TAM3 version like voluntariness, experience, subjective norms, image, job relevance, output quality, demonstrability, computer efficacy, anxiety, and enjoyment. But the users' 'subjective self' is yet to be explored and has not been given that much importance there. Hence in this study, the authors investigated two important components of teachers' ICT related subjective self, comprised of self-efficacy and self-concept, to find out their influence on users' perceived ICT usability.

## Perceived ICT Usability

The size and sphere of educational technology have gone through a massive change through 'ephimeralization' since the time of its invention through the disruptive technology like ink pens. Subsequent innovations like Sidney L. Pressey's Mechanical Teaching Machines (Pressey, 1932) in the 1920s or the boom of ICT enabled new sets of applications simulating human brain through the neural network, deep learning, and artificial intelligence (AI) grabbing almost the whole attention of education technology in the 21st century. Technology adoption and integration in pedagogy is no doubt a difficult task that needs several factors to work in harmony like policy, culture, and support as convincingly revealed in the Venn diagram proposed by McNaught et al. (2000). The role of human factors in ICT use comprised of two facets - skill and intension. Harding (2012) said teacher is one of the most important factors because they are the ones who blend all the educational components to deliver environments for teaching and learning. Wilson-Strydom, Thompson & Hodgkinson-Williams (2005) pointed out that ICT use and ICT integration are two different concepts when the idea of ICT integration in curriculum delivery has a deeper implication than simple ICT/computer literacy or technical knowledge of operations which is meant to be cross-curricular rather than become a separate course or topic in itself. They argued that the acquisition of technical skills and learning about ICTs is implementation without integration whereas learning through or using a computer is referred to as implementation with integration. This proposition gets theoretical support in Technological Pedagogical Content Knowledge (TPACK) framework developed by Mishra & Koehler (2006). In this context, Nkula & Krauss (2014) found ICT integration neither refer to simply placing computers in the classroom nor using technology to sustain traditional teaching methods, rather integration refers to the use of technology to promote teaching-learning, that is, where students use ICTs in acquiring new knowledge and skills making teaching itself an intricate and impressive function. This claim finds evidence in the observation of Aldunate & Mehlenbacher (2010) who asserted research conducted in countries with different cultures report that although there is an increase in the availability of ICT tools in educational institutions still there is an indication that teachers were not using these in expected manner. Balanskat, Blamire, & Kefala (2006) reported that teachers appreciate the role of ICT in classrooms but they continuously find obstacles in using these technologies in the teaching-learning process.

In the words of Argyris, Putnam, & Smith (1985) as put in their book 'Action Science' this phenomenon could be described as what they espoused could not practice making clear distinction between espoused theory and theory-in-use. Kundu (2018) said teachers' roles and willingness to accept educational technology are very vital for its effective integration in pedagogy. In another recent survey in Indian context, Kundu (2020) found efficient ICT equipment are lying stacked, unused

in the store-rooms but teachers do not feel interested in using them. Hatlevik (2017) and Badia et al. (2013) also found several teachers were aware of the technology that was available to them for instructional purposes, yet for one or more reasons, they were not found capitalizing on the unique opportunities to integrate such resources into their classroom practices. A lot of studies found teacher related cognitive factors like beliefs, attitudes, intention, confidence, motivations, readiness, and self-efficacy fundamentals for effective adoption and integration of ICTs in pedagogy (Erdogan, 2011; Harding, 2012; Badia et al., 2013; Oye et al., 2014; Tschannen-Moran & Hoy, 2001). This role of the human internal factors is mentioned more convincingly than anywhere else in the Technology Acceptance Model (TAM) developed by Davis (1989) and in its later extensions. Considering the deep-rooted influence of human psychological factors in technology adoption, more research is desirable to divulge the role of human self in leveraging full potential of ICTs in pedagogy. In this study 'perceived usability' has been used synonymously with 'perceived ease of use' as specified in the TAM3 by Venkatesh & Bala (2008) that connotes "the degree to which a person believes that using a particular system would be free from effort" (p.320). Quesenbery (2001) pointed out usability and user-centered design are iterative that determine how and why people use a product. The term 'usability' encompasses all the qualities of 'ease of use' at the same time relies on user-feedback through evaluation based of 5 Es – effective, efficient, engaging, error-tolerant, and easy to learn - rather than simply trusting on the experience and expertise of the designer (Quesenbery, 2000). This makes the term 'usability' more pertinent in this context.

## Self-Efficacy in ICT Integration

Avant-guard spokesman of self-efficacy concept, Albert Bandura (1997) said self-efficacy is not a global trait rather it is both domain and context-specific, therefore, he stressed that because of the rapid development of technological tools, the pedagogical use of technology may require special types of teacher efficacy. He argued in Benight & Bandura (2004) that if teachers have high self-efficacy regarding their ability to use technology, they will be more willing to adopt new technologies in their classroom practices. Hatlevik & Hatlevik (2018) said 'social cognitive theory' (Bandura, 1997) points to a potential positive effect of individuals' perception of their own competence and capabilities in a specific area of interest (i.e., self-efficacy) for continual growth and a feeling of mastery in that same field and similar fields of interest. Past studies have attributed teacher efficacy for their job satisfaction and professional commitment (Skaalvik & Skaalvik, 2007; Ware & Kitsantas, 2007), attrition from the teaching profession (Klassen & Chiu, 2011; Hong, 2012), and predicting teachers' motivation and achievements (Caprara et al., 2006; Guo et al., 2012). A lot of recent researches have been done exposing the interface between self-efficacy and ICT use supporting Bandura's notion that increased levels of self-efficacy add more confidence in ICT use among teachers (Fanni et al., 2013; Hammond et al. 2011). Furthermore, several studies pointed out users' self-efficacy as instrumental in developing their eagerness to experiment with digital tools, its integration in pedagogy, even amidst poor infrastructural circumstances (So, et al., 2012; Teo, 2014; Hatlevik, 2017; Kundu, Bej & Dey, 2020; Pumptow & Brahm, 2020; Hatlevik & Hatlevik, 2018; Hong, Hwang, Tai, & Lin, 2017; Vayre &Vonthron, 2016; Oye et al., 2014; Al-Ruz & Khasawneh, 2011; Chen, 2008; Lin, Wang & Lin, 2012). Sun & Chen (2016) asserted that teachers who feel uncomfortable using technology are unlikely to incorporate it and have attributed this underutilized technology infrastructure to teachers' lack of self-efficacy. Further, Pumptow & Brahm (2020), Hatlevik & Hatlevik (2018), and Ertmer & Ottenbreit-Leftwich (2010) pointed out the presence of teacher efficacy in every internal human factor for effective ICT integration like technological knowledge, pedagogical knowledge, content knowledge jointly forms teachers' technology efficacy belief. This vast literature review speaks highly on the importance of self-efficacy among teachers to enhance their efficiency in general and ICT use in particular.

## Self-Concept in ICT Integration

Self-efficacy represents one's expectations and convictions of what one can accomplish in a given situation while self-concept represents one's general calculative perception of subjective self in a given domains of functioning. Peiffer, Ellwart, & Preckel (2020) asserted both self-concept and self-efficacy as foremost competence-related self-perceptions that affect human success and failure. Leonard (2020) asserted self-concept is a holistic perception that includes self-efficacy and few other aspects of persons' subjective self. However, the difference between self-efficacy and self-concept has been comprehensively presented in Bong & Skaalvik (2003) when they said the earlier is less concerned with one's skills and abilities and more concerned with their beliefs, expectations, or convictions on what they can do with whatever available when the latter is calculative and regularly engage in routine self-evaluation of the one's skills and abilities necessary to perform the given task. Self-concept is cognitive appraisal of self-worth, past-oriented which is not context sensitive while self-efficacy is judgement of self-confidence, future oriented, and is context sensitive. Weiten, Dunn, & Hammer (2012) said self-concept is a collection of beliefs about one's own nature, unique qualities, and typical behavior. Veiga (2012, p. 20) viewed self-concept as "the perception individuals have of themselves as they are and in relation to others" and this comparative multilayer self-evaluation affects each aspect of emotions, thinking, interest, motivation, and human behavior (Rawat, 2011). Other authors (Gupta & Thapliyal, 2015; Cokley & Patel, 2007; Faria, 2002) defined it as the set of attitudes, feelings, and self-knowledge about one's own capacities, competence, appearance, and social acceptability.

In this perspective, the notion of self-concept is a central element to form one's subjective self, personality, attitudes, behavior, and coping abilities fundamental to understand how one organizes stipulated actions (Ertl, Luttenberger, & Paechter, 2017; McLeod, 2008). Huitt (2004) found that individuals with poor self-concept tend to blame failure on external causes and take full credit for successes. In the same vein Deniz (2007) thought the level of success in ICT integration in schools is not dependent on the quality or sophistication of the technology, but rather on the teachers' readiness and positive disposition. Several past studies attributed this positive disposition towards computers as a prerequisite as well as a catalyst in acquiring a high level of computer literacy and successful pedagogical use of computer technology (Francis, Katz, & Jones, 2000; Garland & Noyes, 2004; Rovai& Childress, 2003; Norhayati, 2000). Thus, considering Computer/ICT related performance outcomes, the allied self-concept becomes a relevant variable (Christoph, Goldhammer, Zylka, & Hartig, 2015). Usually, it is defined as a dynamic phenomenon that affects a persons' ICT-related performance and itself is affected by past experiences with ICT/Computers and a persons' individual environment (Janneck, Vincent-Hoper, & Ehrhardt, 2013; Langheinrich, Schonfelder, & Bogner, 2015). Janneck et al. (2013) presented the ICT or computer-related self-concept as a novelty to evaluate computer-related emotions, attitudes, and behaviors where positive self-concept is equated with positive evaluation, while negative self-concept is associated with negative evaluation. Thus, the above literature review reveals that self-concept is different from self-efficacy both having a considerable role in shaping users' behavioral intention for technology adoption.

## RESEARCH GAP

Technology Acceptance Model (TAM) originally developed by Davis (1989) is one of the most popular research models to predict the use and acceptance of information systems and technology by individual users. TAM has been widely studied and verified by different scholars from different contexts that examine the individual technology acceptance behavior in different information systems constructs. The attitude to use is concerned with the user's evaluation of the desirability of employing a particular information system application. Behavioral intention is the measure of the likelihood of a person employing the application. To make TAM more complete, Venkatesh & Bala (2008) revamped

TAM2 proposed by Venkatesh (2000) and Venkatesh & Davis (2000) to develop a comprehensive nomological network of IT adoption and use called TAM3 (see Fig. 1) by combining TAM2 with the six determinants of Perceived Ease of Use (PEU) - Computer Self-Efficacy, Perceptions of External Control, Computer Anxiety, Computer Playfulness, Perceived Enjoyment, and Objective Usability.

**Figure 1. Technology Acceptance Model-3 (in Venkatesh & Bala, 2008)**
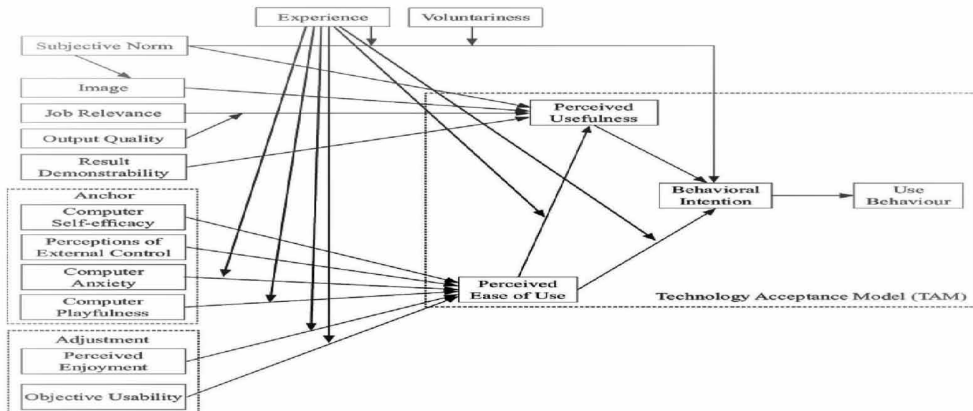


But based on the explored literature in the previous sections the authors find a gap in TAM3 and assumed that specific focus needs be given on the users' 'subjective self' considering the enormous importance of the essentially subjective factors like self-efficacy or self-concept that seeks an extension of TAM3 towards TAM3+. TAM3 has been adopted as a theoretical framework in this study to further investigate the influence of two new independent variables on the same dependent variable, PEU or ICT usability. Authors presumed, TAM3 without considering self-efficacy and self-concept becomes less effective in this current era of autonomy, individualism, and subjectivism, the doctrine originally attributed to Rene Descartes and his *'methodic doubt'* meaning our own mental activity is the only unquestionable fact of our existence (Merlo & Pravato, 2020). Extending this notion, Merlo (2016) asserted that subjectivism accords primacy to personal independent experience as central of all human performance and existence of every object depends exclusively on someone's subjective awareness of it. Targeting this limitation concerning 'subjectivism' in the current TAM3 literature an investigation into users' 'subjective self' has been thought of and designed to find out their potentials in users' perceived usability.

## METHODOLOGY

### Aims

This study followed a descriptive survey method within an ex-post-facto research design with teachers' ICT related self-efficacy and self-concept as the independent variable and their perceived ICT usability (PEU) as the dependent variable. A quantitative correlational study was best suited for this type empirical analysis. Ex-post-facto design was deliberately chosen because it was not possible or acceptable to manipulate the characteristics of human participants or a situation already happened. Besides this method is potent to test hypotheses about cause-and-effect relationships in situations where it is not practical or ethically acceptable to apply the full protocol of a true experimental

design. Salkind (2010) found about ex-post-facto design that despite studying facts that have already occurred, this design shares some of the basic logic of inquiry of experimental research design.The details regarding the method of research design, sample, research instruments, the procedure of data collection, and statistical technique were reported herewith. The specific research question (RQ) set for this study is as follows:

RQ1: How teachers' self-efficacy and self-concept affects their perceived ICT usability?

## Hypothesis Formulation

Based on the literature review and the theoretical framework the following three statistical hypotheses were formulated to investigate into the statistical relationship among the selected variables.

$H_0 1$: There is no relationship between teachers' self-efficacy and perceived ICT usability.
$H_0 2$: There is no relationship between teachers' self-concept and perceived ICT usability.
$H_0 3$: Teachers' self-efficacy and self-concept do not affect their perceived ICT usability.

The proposed research model adopts in this study seeks an extension of the TAM3 having self-efficacy and self-concept as the selected factors within a new domain - 'subjective self'. The dotted line in the path diagram in Fig. 2 shows the proposed inter-relationships among three variables which is the main objective of this investigation to empirically assess the authenticity of the proposed TAM3+.

Figure 2. Path diagram of the hypothesized relationship
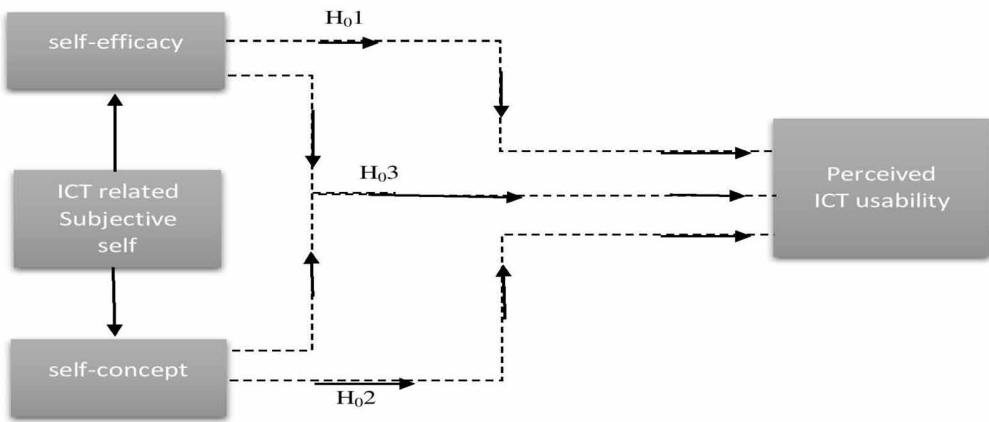


## Sites and Participants

The survey was conducted among 300 Indian secondary school teachers from 50 schools following a stratified random sampling technique. The schools were under the administrative control of either West Bengal Board of Secondary Education or Central Board of Secondary Education, the two major government monitoring authorities of school education within the delimited area in India. All participating teachers has been taking classes in the secondary level from 5th to 10th grades. ICT based teaching-learning was not a general phenomenon in this country at least before the COVID-19 pandemic owing to several limitations starting from orthodox teacher-worshiping culture,

lack of digital infrastructure to e-content and skilled teachers (NEP, 2020; Kundu, Bej, & Rice, 2020; Kundu, & Bej 2020a; Kundu, Bej, & Dey, 2021); Kundu, & Bej, 2021). Hence in choosing schools and participants, minimum awareness and ICT infrastructure was taken into consideration as a vital inclusion criterion and selected only those having an official ICT labs or computers. The heterogeneous sampling method allowed to include a diverse range of cases relevant here to gain as much insight from as many angles as possible. Upholding heterogeneity of the population the researchers considered five different demographic variables/category variables- district, gender, age, management, and location- the domains where the country's digital inequalities are very prominent (MHRD, 2018; Kundu, & Bej, 2020). The purpose of this kind of sample design is to provide as much insight as possible into the event or phenomenon under examination (Etikan, 2017). The actual names of the participants were withheld honoring research ethics. Detail demographic description of the participants is presented in Table 1.

Table 1. Demographic description of the participants

| Demographic Variable | Frequency (N=300) | Percentage (%) |
|---|---|---|
| **District** | | |
| Bankura (BNK) | 60 | 20 |
| Purulia (P) | 60 | 20 |
| Paschim Medinipur (PM) | 60 | 20 |
| Paschim Burdwan (PB) | 60 | 20 |
| Birbhum (BIR) | 60 | 20 |
| **Gender** | | |
| Male (M) | 200 | 66.67 |
| Female (F) | 100 | 33.33 |
| **Age Groups (years)** | | |
| 20–30 (Y1) | 101 | 33.67 |
| 31–40 (Y2) | 92 | 30.67 |
| 41–50 (Y3) | 44 | 14.66 |
| More than 51 (Y4) | 63 | 21 |
| **Management types** | | |
| Government (G) | 215 | 71.67 |
| Private (P) | 85 | 28.33 |
| **School Location** | | |
| Urban (U) | 142 | 47.33 |
| Rural (R) | 158 | 52.67 |

## Research Tools

To put TAM3 in the context of ICT use for teaching-learning was a difficult task as researchers felt since there were no available instruments to assess the three ICT-related psychological constructs/ major variables in this study- self-efficacy, self-concept, and PEU. The researchers had to develop three scales and, in the making, they framed a unique scale development model as well which they named as Comprehensive Model of Scale Development (CMSD). All three scales used in this study were developed and standardized following this model. This model (in Fig. 3), the authors hope, will help and accost future scale development.

**Figure 3. Comprehensive Model of Scale Development**
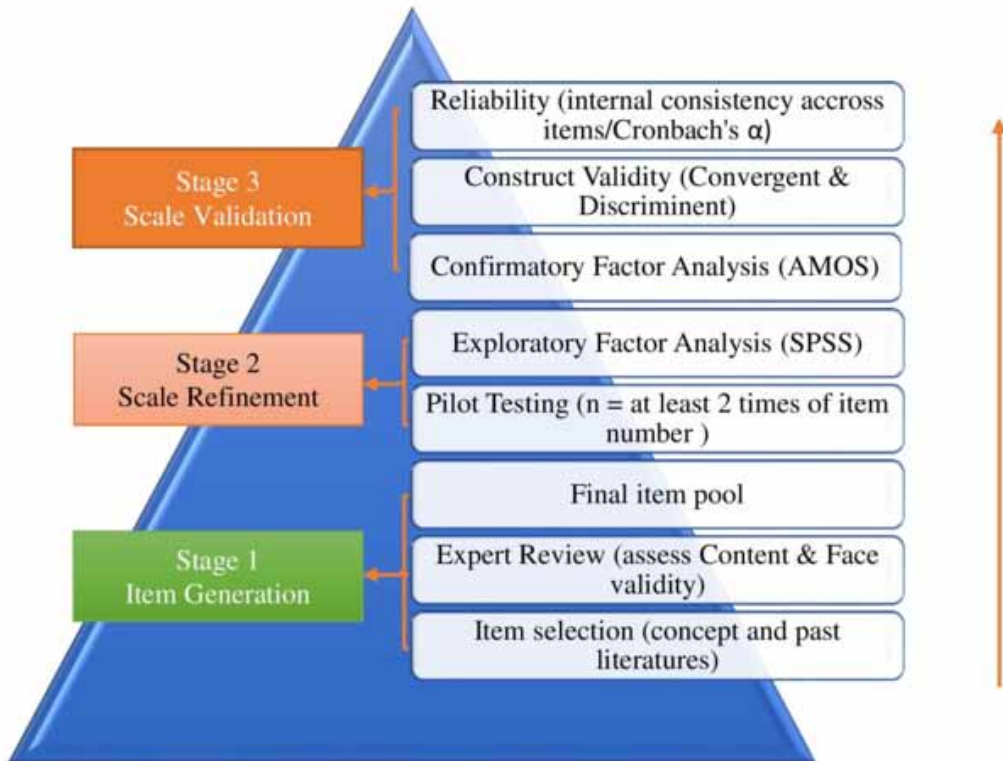


*ICT Self-efficacy Scale.* This scale was developed by the researchers following the CMSD model. In the 1st stage the university professors, scholars, and past scales of similar domains like Musharraf, Bauman, Anis-ul-Haque, & Malik (2018) played a vital role still the making of the final item pool of 30. Each item was translated in both English and Bengali attached with a 5-point Likert scale (1=strongly disagree to 5=strongly agree). In the $2^{nd}$ stage pilot test was conducted among 60 participants (double of the items) and data were run for Exploratory Factor Analysis (EFA) in SPSS (version 22). The outcomes reveal the **KMO value** 0.819 which was greater than its threshold value of 0.7 and a significant level (0.000) of **Bartlett's test of Sphericity** suggested for a substantial correlation in the data. Three variables were found to have **Eigenvalues**> 1indicative of three factors which was further upheld in the Scree Plot analysis. The Rotated Component Matrix found 10 items having cross loading and removed to get a better KMO value (0.9). **Communalities** extracted were all above the threshold value of 0.5. In the $3^{rd}$ stage scale validly was determined by copying the **Rotated Component Matrix** to the IBM SPSS AMOS (version 26). The three factors were named as- Technological Efficacy (TE), Pedagogical Efficacy (PE), and Integration Efficacy (IE). From Plugin the **Master Validity** was tested. The results reported *'no validity concerns here'*. The Convergent Validity (a type of Construct Validity) was found acceptable complying with all three major conditions as follows:

a) CR (Composite reliability) = 0.921>0.7
b) AVE (Average Variance Extracted) =0.82> 0.5
c) CR>AVE

Divergent Validity (another type of Construct Validity) was also found acceptable in the observation method having the diagonal values (square of AVE) greater than vertical values (correlation values, MSV) meaning (AVE>MSV). Reliability was evident in the Composite Reliability (CR) during testing Convergent Validity. Still, the Internal Consistency Measure (Cronbach's α) was done separately that found same (0.921) which was of excellent degree that strongly supports the scale being effective to be used for the desired purpose. The final scale used for this survey was consist of 20 items divided into three domains - Technological efficacy (comprising question items 1-8 having Cronbach Alpha (α) =0.85), Pedagogical efficacy (comprising question items 9-16, Cronbach Alpha (α)=0.88), and Integration efficacy (comprising question items 17-20, Cronbach Alpha (α)=0.89), covering three important facets of teachers' ICT related self-efficacy.

*ICT Self-concept Scale.* This scale was also developed by the researchers following the same CMSD model. In the 1st stage the final item pool reached with 20 and each item was attached with a 5-point Likert scale (1=strongly disagree to 5=strongly agree). In the 2nd stage pilot test was conducted among 60 participants (more than double of the items) and data were run for Exploratory Factor Analysis (EFA) in SPSS (version 22). The outcomes reveal the **KMO value** 0.812 which was greater than its threshold value of 0.7 and a significant level (0.000) of **Bartlett's test of Sphericity** suggested for a substantial correlation in the data. Three variables were found to have **Eigenvalues**> 1indicative of three factors which was further upheld in the Scree Plot analysis. The Rotated Component Matrix found 5 items having cross loading and removed to get a better KMO value (0.842). **Communalities** extracted were all above the threshold value of 0.5. In the 3rd stage scale validly was determined by copying the **Rotated Component Matrix** to the IBM SPSS AMOS (version 26). The three factors were named as- Emotional, Social, and Academic. From Plugin the **Master Validity** was tested. The results reported *'no validity concerns here'.* The Convergent Validity (a type of Construct Validity) was found acceptable complying with all three major conditions as follows:

d) CR (Composite reliability) = 0.89>0.7
e) AVE (Average Variance Extracted) =0.72> 0.5
f) CR>AVE

Divergent Validity (another type of Construct Validity) was also found acceptable in the observation method having the diagonal values (square of AVE) greater than vertical values (correlation values, MSV) meaning (AVE>MSV). Internal Consistency Measure (Cronbach's α) was done separately that found same (0.89) which was of excellent degree that strongly supports the scale being effective to be used for the desired purpose. The final scale used for this survey was consist of 15 items divided into three domains - Emotional (having Cronbach Alpha (α) =0.81), Social (having Cronbach Alpha (α)=0.85), and Academic (with Cronbach Alpha (α)=0.9), covering three important facets of teachers' ICT related self-concept.

*Perceived Ease ICT Use Scale.* The 3rd scale developed by researchers in this study following the CMSD. In the 1st stage final item pool appears 25 each attached with a five-point Likert scale ranged from 1= strongly disagree to 5= strongly agree with higher scores indicating stronger perceived ease of ICT use. In the 2nd stage pilot test was conducted among purposively selected 75 target participants (thrice of the item number) and data were run for Exploratory Factor Analysis (EFA) in SPSS (version 22). The outcomes reveal the **KMO value** 0.739 which was greater than its threshold value of 0.7 and a significant level (0.000) of **Bartlett's test of Sphericity** suggested for a substantial correlation in the data. Three variables were found to have **Eigenvalues**> 1indicative of three factors which was further upheld in the Scree Plot analysis. The Rotated Component Matrix found 5 items having cross loading and removed to get a better KMO value (0.88). **Communalities** extracted were all above the threshold value of 0.5. In the 3rd stage scale validly was determined by copying the **Rotated Component Matrix** to the IBM SPSS AMOS (version 26). The three factors were named as- *Perceived Ease (PE), Perceived Usefulness (PU), and Behavioral Intention (BI).*

From Plugin the **Master Validity** was tested. The results reported *'no validity concerns here'.* The Convergent Validity (a type of Construct Validity) was found acceptable complying with all three major conditions as follows:

g) CR (Composite reliability) = 0.92 >0.7
h) AVE (Average Variance Extracted) =0.83 > 0.5
i) CR>AVE

Discriminant Validity (another type of Construct Validity) was also found acceptable (as per the 2nd method of observation) which revealed the *diagonal values* (square of AVE)>*vertical values* (correlation values). At the final stage, Reliability was tested though it was already found in the form of Composite Reliability (CR) during testing Convergent Validity. Internal Consistency Measure (Cronbach's α) of the scale was done separately that found 0.94 (excellent degree) for the composite scale being effective to be used for the desired purpose. The factor wise Internal Consistency Measure (Cronbach's α) were found 0.87, 0.86, & 0.91 respectively for PE, PU, & BI.

## Data Collection

IRB (Institutional Research Board) approval from Bankura University, West Bengal, India was obtained by the corresponding author. Before distribution of the survey the researchers obtained permission from the school managing committees/head of the institutions available. The researcher prepared the 'Consent form' and informed the participants regarding the intent of the study, and ensured to protect the privacy and confidentiality of the participants. A pilot version of the surveys was initially administered to a limited number of respondents with different characteristics to establish the effectiveness of the designed 3 tools. Testing the survey design helped to ensure that the used tools and question items were easily understandable as well as to check for validity (i.e., the items were asking what we wanted to learn) and reliability. Then the main survey was bodily distributed among 400 participants by January 2020 but in the meantime, the arrival of COVID-19 pandemic (Novel coronavirus named 'Covid-19') with eventual school closure hampered the process of response collection and eventually, by December 2020 only 309 replies were collected. Out of which 300 were found in order and considered for analysis making the response rate a little bit low at 75%.

## Data analysis

Data were analyzed following the proposed research model and results were presented in several Tables. Descriptive as well as inferential statistics and underlying relationships among variables were investigated using appropriate statistics with the help of Statistical Package for the Social Sciences (SPSS-22) software. Descriptive statistics (mean and SD) were used to evaluate teachers' perception of self-efficacy, self-concept, and perceived ICT usability. Pearson's correlation and regression were the major inferential statistics calculated to assess the effects between the dependent variable and the two independent variables.

## RESULTS

Description of the state of self-efficacy, self-concept, and perceived ICT usability
The final 300 participants in this study were varied in several aspects- race, experience, subjects taught, as well as gender. But to keep the research aim only five demographic variables were attended-district, gender, age, school management, and school location. Results regarding the current scenario of teachers' ICT related self-efficacy, self-concept, and perceived usability have been reported in Table 2. That shows ICT self-efficacy among the respondent teachers appears at moderate level (Mean=43.82, Std. Deviation=7.05).

Table 2. Descriptive statistics of self-efficacy, self-concept, and perceived ICT usability

| Variables (N=300) | Mean | Std. Deviation |
|---|---|---|
| Self-efficacy | 43.82 | 7.05 |
| Self-concept | 29.06 | 7.77 |
| Perceived ICT usability | 75.80 | 10.97 |

The frequency distribution histogram of the self-efficacy scores presented in Fig. 4 shows an approximate normal distribution and is slightly positively skewed (Skp= 0.41) that indicates more individuals in the group score less than the average score for their group which is further explained through the Mode score (39). This brings the conclusion that teachers' overall ICT self-efficacy is medium to low as per the measurement scale used in this study.

Figure 4. Frequency distribution of self-efficacy scores
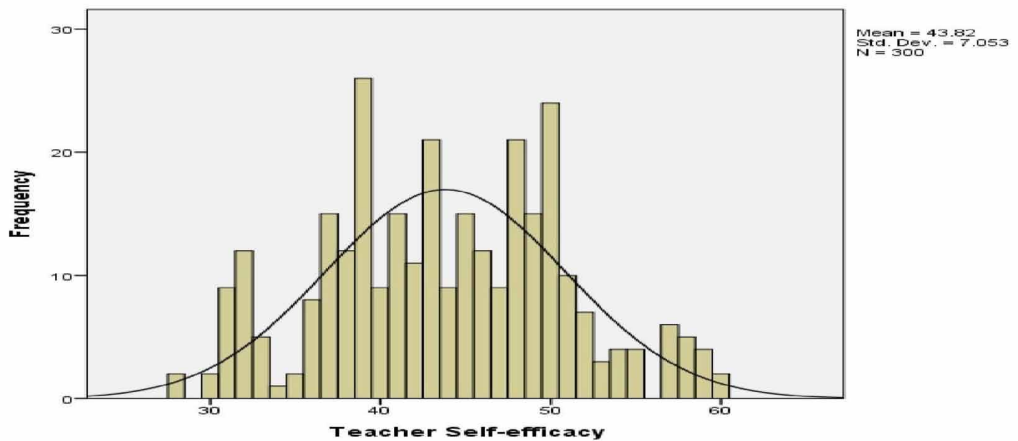


Overall descriptive statistics regarding the current state of teachers' ICT self-concept as appears in Table 2 also shows an overall moderate level of self-concept (Mean =29.06, Std. Deviation =7.77). The frequency distribution histogram of the ICT self-concept scores presented in Fig. 5 shows that the distribution is slightly negatively skewed ($S_{kp}$ = -.08) that indicates there are very few individuals in the group who score more than the average mean score for their group which may be ignored since skewness is very almost insignificant. This conveys the implication that respondent teachers' overall perception of self-concept is of medium level.

Descriptive statistics on the current scenario of respondents' perceived ICT usability as appears from Table 2 indicates a moderate level of perceived ease of ICT use among them (Mean=75.8, Std. Deviation=10.9). The frequency distribution histogram of the teachers' ICT usability scores presented in Fig. 6 shows that the distribution is slightly negatively skewed (Skp= -.63) that indicates more individuals in the group score more than the average mean score for their group. This conveys the inference that respondent teachers' overall perceived usability is medium to slightly high.

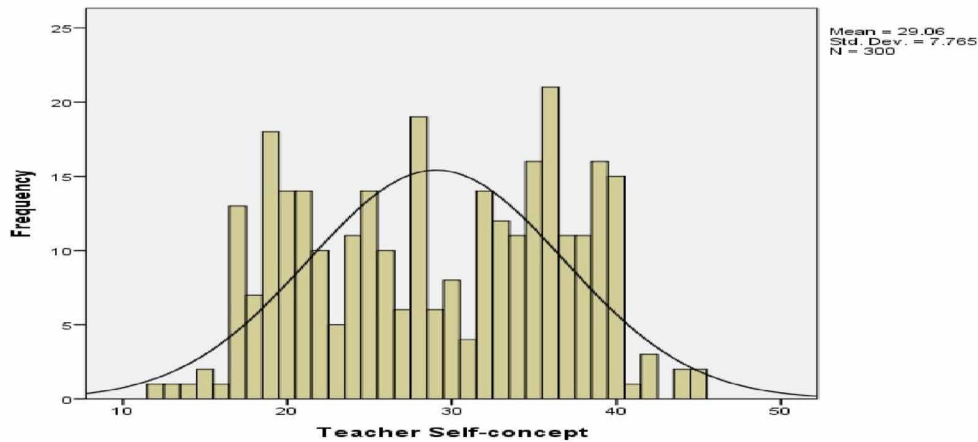**Figure 5. Frequency distribution of self-concept scores**



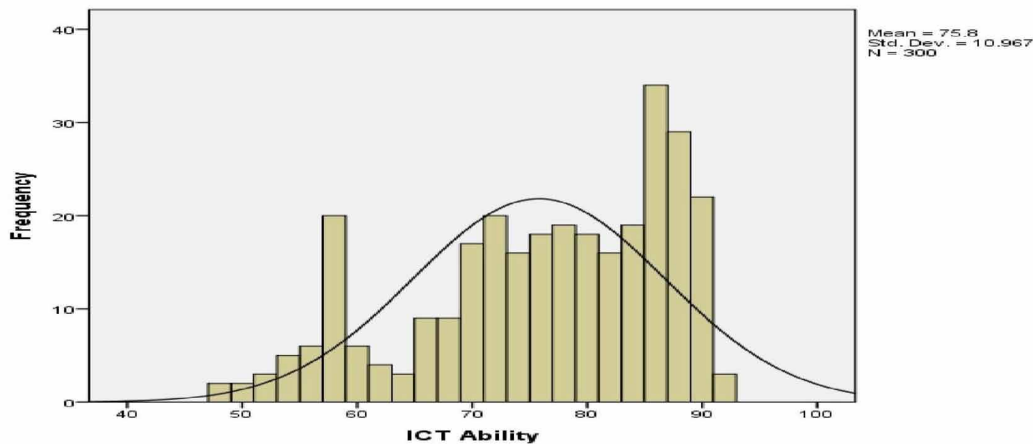**Figure 6. Frequency distribution of teachers' perceived ICT usability scores**



**Table 3. Correlation between self-efficacy and perceived ICT usability**

| Variables | | ICT usability | Teacher Self-efficacy |
|---|---|---|---|
| ICT usbility | Pearson Correlation | 1 | .68* |
| | Sig. (2-tailed) | | .000 |
| | N | 300 | 300 |
| Teacher Self-efficacy | Pearson Correlation | .682** | 1 |
| | Sig. (2-tailed) | .000 | |
| | N | 300 | 300 |

* Correlation is significant at the 0.05 level (2-tailed)

## Investigating Null Hypothesis One

The correlation between teachers' self-efficacy and perceived ICT usability was determined through Pearson Correlation measure in Table 3 and the correlation coefficient (r) is found .68 at the significant level $p=.000<.01$ which indicates towards a significantly moderate and positive correlation between the two variables. The outcome of this correlation analysis confirms a rejection of the 1st null hypothesis and it gets confirmed that when teachers grow with the self-efficacy their perceived ICT usability tends to increase.

It is well known that a correlation analysis provides information on the strength and direction of the linear relationship between two variables, while an analysis of simple linear regression estimates parameters in a linear equation that can be used to predict values of one variable based on the other. Hence, to investigate further the effect of self-efficacy (TSE) values on teachers' perceived ease of ICT use, a simple linear regression was also conducted and its summary is presented in Table 4 that shows the effect of self-efficacy on teachers' ICT usability is statistically significant hence, the 1st Null hypothesis is rejected. It is also evident from this table that when ICT self-efficacy is the only predictor, the teachers' usability/ease of use is expected to be affected by following this formula:

## [Perceived ease of ICT use = 29.36 + (.68) Self-efficacy]

In Table 4, the beta coefficient (β) or the degree of change in the outcome variable for every one unit of change in the predictor variable, is $+0.68$ that means for 1 standard unit increase in self-efficacy, the perceived ease of ICT use will be increased by 0.68 standard unit. $R^2$ (goodness-of-fit) is found 0.47 indicating a moderate effect and the percentage of the variance in the dependent variable that the

Table 4. Regression results for self-efficacy predicting on perceived ICT usability

| Sl. No. | Predictors | R | $R^2$ | F (1, 298) | Sig. | B | β | t | p |
|---|---|---|---|---|---|---|---|---|---|
| | | .68 | .47 | 258.54 | 0.000* | - | - | - | - |
| | Constant | - | - | - | - | 29.36 | - | 10.04 | .000* |
| 1 | TSE | - | - | - | - | 1.06 | .68 | 16.08 | .000* |

*p<.05, TSE=Teachers' self-efficacy

Figure 7. Scatter plot showing self-efficacy predicting perceived ICT usability
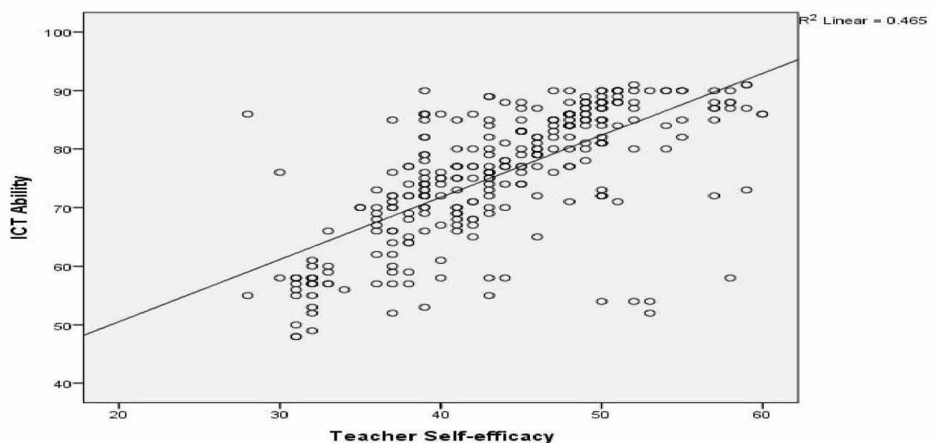
independent variables explain collectively. $R^2$ measures the strength of the relationship between the model and the dependent variable on a convenient $0 – 100\%$ scale (Robson, Pemberton & McGrane, 2008). This statistic indicates the percentage of the variance in the <u>dependent variable</u> that the <u>independent variables</u> explain collectively. The scatter plot analysis in Fig. 7 visually represents the $R^2$ that the model explains 47% of the fitted data in the regression.

## Investigating Null Hypothesis Two

In order to investigate the interrelationship between teachers' self-concept and perceived ICT usability the 2nd null hypothesis was assumed and to test its significance a Pearson correlation analysis was conducted and the results presented in Table 5. The correlation coefficient (r) is found .88 at the significant level p=.000<<.05 hence, the 2nd null hypothesis is also rejected which indicates a strong positive correlation between the two variables.

Table 5. Correlation between self-concept and perceived ICT usability

| Variables | | | ICT Ability | Teacher Self-concept |
|---|---|---|---|---|
| ICT Ability | Pearson Correlation | | 1 | .88* |
| | Sig. (2-tailed) | | | .000 |
| | N | | 300 | 300 |
| Teacher Self-concept | Pearson Correlation | | .879** | 1 |
| | Sig. (2-tailed) | | .000 | |
| | N | | 300 | 300 |

*Correlation is significant at the 0.05 level (2-tailed).

Investigating the effect of teachers' ICT self-concept on their ICT usability another simple linear regression was conducted and the results are presented in Table 6 that shows the effect of self-concept on teachers' usability is statistically significant ($R^2$=77, p<.05) and hence, the 2nd null hypothesis is also rejected. It means, when self-concept is the only predictor, the teachers' ability of perceived ICT usability is expected to be influenced as per the following formula:

**[Perceived ICT usability = 39.73 + (.88) self-concept]**

Table 6. Simple regression for self-concept predicting on perceived ICT usability

| Sl. No. | Predictors | R | $R^2$ | F (1, 298) | Sig. | B | β | t | p |
|---|---|---|---|---|---|---|---|---|---|
| | | .88 | .77 | 1012.75 | 0.000* | - | - | - | - |
| | Constant | - | - | - | - | 39.73 | - | 33.86 | .000* |
| 1 | Self-concept | - | - | - | - | 1.24 | .88 | 31.82 | .000* |

*p<.05

In Table 6, the beta coefficient (β) is +0.88 that means for 1 standard unit increase in self-concept, the perceived ease of ICT use will increase by 0.88 standard unit. $R^2$ (goodness-of-fit) is found 0.77 indicating a substantial effect and the percentage of the variance in the dependent variable that the

independent variables explain collectively. This statistic indicates the percentage of the variance in the <u>dependent variable</u> that the <u>independent variables</u> explain collectively. The scatter plot analysis in Fig. 8 visually represents the $R^2$ that the model explains 77% of the fitted data in the regression model.

Figure 8. Scatter plot showing self-concept predicting perceived ICT usability
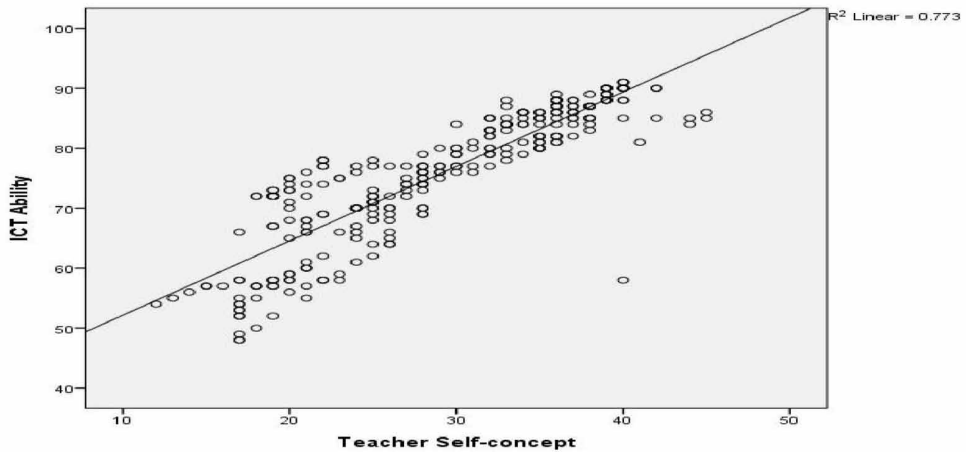


## Investigating Null Hypothesis Three

Now, concerning the central focus and main outcome of this study that is investigation of the combined effects of self-efficacy and self-concept (named subjective self) on teachers' perceived ICT usability, the 3rd null hypothesis was formed and to test its statistical significance the following operations were done. The multiple linear regression was conducted taking self-efficacy and self-concept as predictor variables and teachers' perceived ease of ICT use as criterion variable. The model summary of which is reported in the Table 7.

Table 7. Multiple regression summary for self-efficacy and self-concept predicting perceived ICT usability

| Sl. No. | Predictors | R | R² | F (2, 297) | Sig. | B | β | t | p |
|---|---|---|---|---|---|---|---|---|---|
| | | .89 | .79 | 568.55* | 0.000* | - | - | - | - |
| | Constant | - | - | - | - | 31.96 | - | 17.5 | .000* |
| 1 | Self-efficacy | - | - | - | - | .292 | .19 | 5.4 | .000* |
| 2 | Self-concept | | | | | 1.07 | .76 | 21.7 | .000* |

*p<.05

The above multiple regression analysis is found highly significant with (p=.000<<.05) and hence the 3rd null hypothesis of this study is also rejected with the conclusion that both the independent variables have statistically significant effect on the dependent variable that is teachers' perceived ICT usability. The regression model is effective and the 80 percent of the dependent variable is significantly

affected by the combined influence of the independent variables ($R^2$=.80). The coefficient results show the effects of each of the independent variables on the dependent variable. It is evident that self-concept made deeper statistically significant individual contribution to this mutual prediction on the teachers' perceived ease of ICT use ($\beta$ = .76, t=21.7, p<.05) than self-efficacy ($\beta$ = .19, t=5.4, p<.05) meaning self-concept is found as a stronger predictor than self-efficacy in enhancing teachers' perceived ease of use though much less in degrees than its individual and lone influence on the perceived usability as reflected in Table 4&6. Based on this outcome the following regression equation can be formed:

## [Perceived ICT usability = 31.96 +(0.19) self-efficacy + (.76) self-concept]

From this outcome equation, it is evident that for every 1 standard unit simultaneous increase in self-efficacy and self-concept each, the perceived ease of ICT use will increase by 0.95 standard unit. The histogram (in Fig. 9) is in critical bell shapes and most of the data are inside the shape. The normal probability plot (in Fig. 10) shows most data follow a linear pattern. Hence it can be concluded that there are no issues relating to the normality or probability of the data. These two are important assumptions of multivariate analysis and thus should be fulfilled in multiple linear regression model (Hair, et al. 2010). The normality can be checked through observing the normal p-p plots and standardized residual histogram. In normal p-p plots, the standardized residual is compared with normal distribution represented by straight diagonal line which is a graphical technique for assessing whether or not a data set is approximately normally distributed (Chambers et al., 1983).

**Figure 9. Standardized residual histogram of the regression**
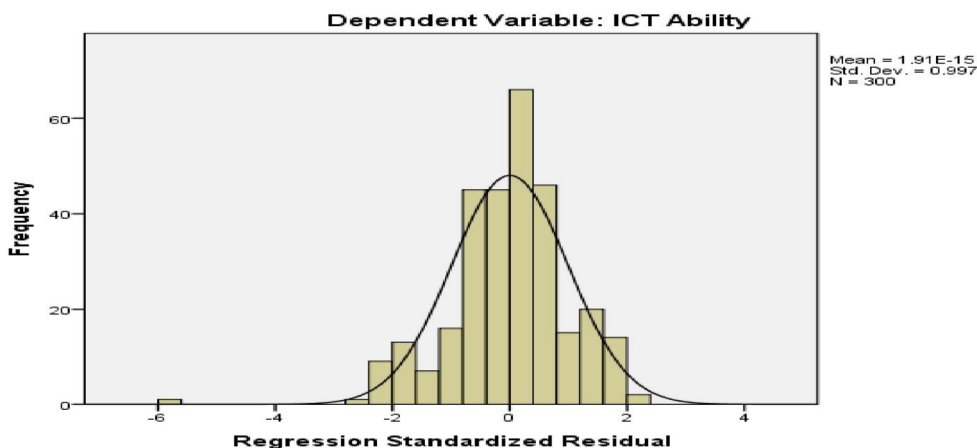


The Standardized Residual Histogram is based on the idea that the *z*-scores of individual studies, also known as standardized residuals, are expected to follow a normal distribution around the combined effect size (Sutton et al., 2000). In this regress analysis the histogram is found a bell-shaped symmetrical curve having maximum scores in the middle and lesser at the edges.

On the other hand, the linearity is checked through observing the scatter plots of standardised residuals of dependent and independent variables (Pallant, 2010). The scatter plot analysis of this regression model is presented in Fig. 11 that also exhibits data somewhat follow a linear path and the linear pattern is evidence of a high linear correlation among the variables. R-squared calculates the amount of variance of the target variable explained by the model, i.e., function of the independent

Figure 10. Normal probability plots of the multiple regression
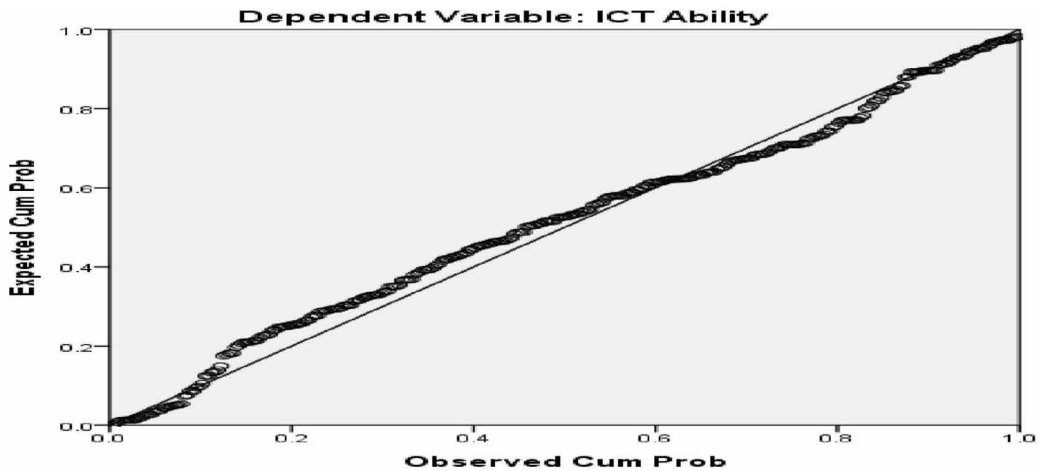


variable. $R^2$ value (.79) indicated a strong effect at the same time suggests a better fit for the model. The uphill pattern as you move from left to right, this indicates a positive relationship between the dependent and the unstandardized predicted values meaning teachers' perceived ease of ICT use or ICT usability is expected to increase with the combined increase in their ICT self-efficacy and ICT self-concept.

Figure 11. Scatter plots analysis of the multiple regression
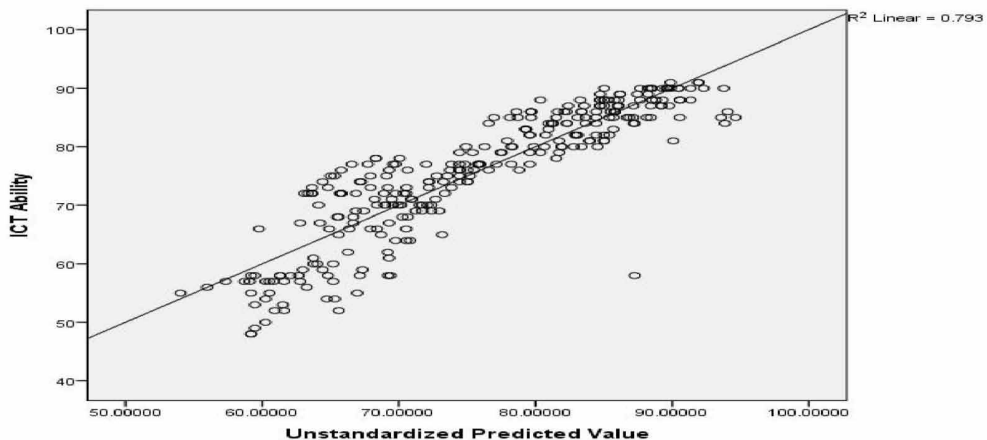


## DISCUSSION

The results of this investigation revealed a scenario with significant predictions of teachers' self-efficacy and self-concept on their perceived ICT usability. Both the independent variables found to have individual as well as combined effect of the dependent variable. The statistical analysis in the form of a multiple regression analysis in Table 7 reports the results of this interrelationship. It was found that both the two independent variables had a significant effect on the dependent variable that

is teachers' perceived ease of ICT use and expectedly, their combined effect is more potent than their individual effects on the dependent variable. Self-efficacy and self-concept jointly predict 79% of the dependent variable, when individually self-efficacy predicts 47% and self-concept does over 77% variability. Besides, it is evident that self-concept made deeper statistically significant individual contribution to this mutual prediction on the teachers' ICT usability ($\beta = .76$, t=21.7, p<.05) than self-efficacy ($\beta = .19$, t=5.4, p<.05). Meaning is that self-concept is found a stronger predictor than self-efficacy in enhancing teachers' perceived ease of ICT use though much lees in degree than its lone influence on the usability as reflected in Table 7. This finding also upholds the theoretical proposition that human self-efficacy is a part of the overall self-concept naturally the influence of latter ordained to be deeper than the earlier. The regression equation *(ICT ability = 31.96 + (0.19) self-efficacy + (.76) self-concept)* comes out of this study is potent to predicts a teachers' ease of ICT use if his/her self-efficacy and self-concept are known which is the main outcome of this survey. Pictorial depiction has been made with the help of consequences over the proposed structural equation model in Fig. 12.

**Figure 12. Output path diagram and consequences of the proposed structural equation**
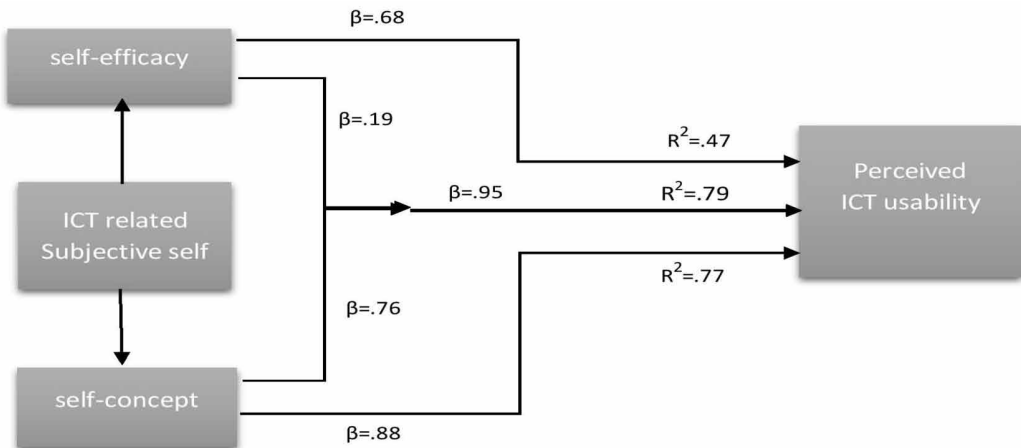


The above model demonstrating the main findings that teachers' 'subjective self' significantly affects their perceived ease of ICT use and there is a high positive correlation between the two variables. Thus, the proposed research plan already stated in the Fig. 2 seeking a further extension of the TAM3 by adding a newly proven domain as user's technology related 'subjective self' with two confirmed cognitive factors, self-efficacy and self-concept, has been empirically established and the new domain is found having statistically significant effect on the users' perceived ease of ICT use. The extended TAM3 model or alternatively the TAM3+ will appear as presented in Fig. 13.

## CONCLUSION

The current study concludes with this note that the teachers' ICT-related 'subjective self' comprised of cognitive units like self-efficacy and self-concept was statistically significant in predicting their perceived ICT usability. It is evident that for every 1 standard unit simultaneous increase of self-efficacy and in self-concept, the perceived ease of ICT use will be increased by 0.95 standard unit. Individually also for 1 unit increase in self-efficacy the perceived usability will increase by 0.68 unit and for 1 unit increase in self-concept, the received usability will increase by 0.88 standard unit. This

outcome supports the previous claims as proposed in different versions of the TAM that technology use depends on several ever-evolving and multipronged human factors. From this empirical outcome, the authors hereby proposed a further extension of the TAM3 towards the TAM3+ by adding a new domain as users' 'subjective self' that can contribute significantly to their perceived usability. This new cognitive domain has significant prediction over the dependent variable having the capability to predict up to 79% variance of the users' perceived usability. Though, self-concept evolved as a more impactful predictor on users' perceived usability than their self-efficacy. The consequent structural equation model (in Fig.12) that came out of this investigation advocates this restructuring of TAM3 and proposed formation of the TAM3+ as described in Fig.13.

Figure 13. Proposed TAM3+ model
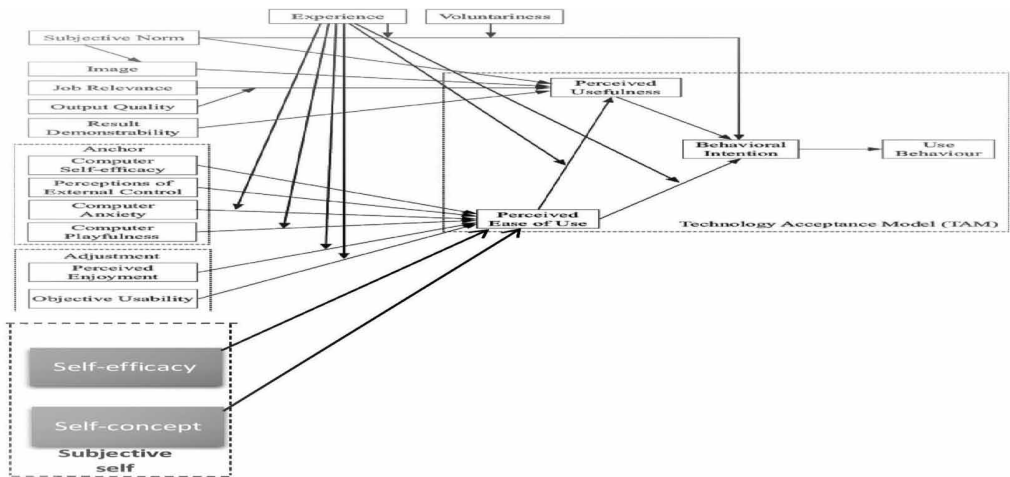


## IMPLICATIONS

Pedagogical: Carol S. Dweck in her book *Mindset: The New Psychology Of Success* has wrote Becoming is better than being and she has been found to deny ability putting her sole focus over effort which is what ignites that ability and turns it into accomplishment (Dweck, 2006). This has been found echoing Kabiguru Rabindranath Tagore who also talked about a self-relative universe "amari chetonar ronge panna holo sobuj, chuni hoye uthlo ranga hoye" (Tagoreweb, n.d.). This study applies this notion of self in teachers' pedagogical use of ICT and found its immense importance to prepare them with a positive mindset for this particular task. Knowledge is a continuous process and it renewed itself with the advocacy for the solutions of new problems and having a growth mindset (Dweck, 2006). The future education will entail problem-based learning, immersion, and simulation with technology having the leading role in knowledge transmission. Here the positive change of users' attitude and behavioural intention towards this change is a necessity. This empirical investigation revealing to teachers' self-efficacy and self-concept have a potential impact on their perceived ICT usability that is ease of use with an evaluation of its efficiency. The implication is that when they are having a strong subjective self, they find ICT use is easier and more efficient. Since self-conviction or self-concept depends less on external parameters and more on introspection and innovation this finding could be especially effective in developing countries like India where e-infrastructure for teaching-learning is still in a withered form. Here a sound counselling framework with an apposite training intervention for teachers (a part of 2nd stage of this research as well) could substantially inspire them to concentrate over what they are having instead of lamenting over what is not.

Technical: The proposed restructuring of TAM3 towards TAM3+ is itself implicative which is domain neutral and covers any field of technology use. The proposed 'subjective self' domain and its manipulation will help better performance and achievement. Self-efficacy and self-concept are present in every human being irrespective of the field he/she has been operating. Enhancement and enforcement of this domain will promote their ease and efficiency in technology adoption. The three research tools designed for this investigation along the unique Comprehensive Model of Scale Development (CMSD) are vital technical implication of this study that will lessen the burden of future researchers in this aspect.

Social: Before conclusion authors remember William James (William James Quotes. (n.d1.) when he said the greatest discovery of my generation is that a human being can alter his life by altering his attitudes. 'Ephemeralization' and the fast-changing information environment across the globe call for the appropriate use of modern technology because it has become a tool that promotes access and uses up-to-date information resources for advanced productivity and development. In the 21st century, efficient access and utilization of information resources depend on the ability to effectively use the ICT tools. The inability to demonstrate expertise in this area can lead to ICT resistance which has been acknowledged as the main reason leading to impediment in embracing new and innovative technology. This can lead to many organizations investing in the new way of doing things and yet it will be underutilized by their workers. Understanding technology acceptance and the role of users' 'subjective self' will lead to better prediction of the use of new information resources and the building of a new information society. The implication gets deeper in the current post-COVID-19 new normal where ICT has occupied a vital role almost in every sphere human life in some way or other (Kundu & Bej, 2020b). Here, the authors feel to get better involvement in ICT application the assessment, enhancement, and enforcement of users' *subjective self* bears resonance and deep implication.

## Projection of Future Work

The TAM3+ model proposed in this study (in Fig. 12) needs to be tested empirically to substantiate the proposition held in this argument. In future, the authors will attempt to test the effectiveness of this restructuring with experimental design. Before that suitable counseling designs need to be framed to strengthen users' subjective self along with their self-efficacy and self-concept. A large-scale survey is also hereby proposed as future work to further authenticate the TAM3+ with preference over cross-country participations. The probe into other factors under this subjective self like self-esteem, self-image, etc. also need to be conducted to reflect on the holistic subjective effects in technology adoption.

## Limitation

Initially the authors targeted to reach among 400 participants and collect their responses but the sudden pandemic arrival of COVID-19 in the pick period of data collection by March 2020 and compulsive school closures for a prolonged period hampered the collection of responses and eventually only 309 responses were collected out of which 300 were considered for data analysis. This curtailed the survey limit which was no doubt a limitation in this study. Reaching the full limit of the participants (400) or more than this could give a more accurate and better-balanced outcome. Besides, owing to time and resource limitations, the survey could cover only five districts of a single Indian state and a specific region, long been suffered under pangs of marginalization, orthodox ethnicity, Maoist extremism, with high poverty, low female literacy, relegated educational infrastructure, teacher dominated classrooms, and low internet/mobile penetration. These factors may affect the participants and their psychological mindsets during their responses. Most importantly, the human cognitive structure is always complex and ever elusive (Kundu, Bej, & Adhikari, 2020) naturally to investigate these cognitive domains becomes difficult and tends to appear specious. All these put together may produce anomalous outcome, a little bit different from the conclusion this study reaches.

### Ethical Declarations

In this study, all declared ethical measures were followed. After obtaining permission from the school officials, the researchers had introduced themselves, explained the objectives of the study among the participants, and the written consent was obtained from participating in the study. They were made fully assured that all information collected from them will remain confidential. This study was approved by the Ethics Committee of Bankura University, India.

### Consent for Publication

Availability of data and materials: The data that support the findings of this study, the original research tools developed in course of this study, and the CMSD are available from the corresponding author on request.

### Conflict of Interests

The authors hereby declare that they have no conflict of interests in the publication of this manuscript.

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