

## The Theory of Planned Behaviour (TPB): Development, Validity and Reliability of an Instrument for measuring its Explanatory Constructs in Teacher Training Colleges in Tanzania

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### ABSTRACT

*The Theory of Planned Behaviour (TPB) stipulates that actual behaviour (AB) is predicted by behavioural intention (BI) and perceived behavioural control (PBC). In turn BI is predicted by attitude toward behaviour (ATB), subjective norm (SN) and PBC. ATB in turn, is predicted by behavioural beliefs and outcome evaluation (bboe); SN is predicted by normative beliefs and motivation to comply (nbmc); and PBC is predicted by control beliefs perceived facilitation (cbpf). Three questions guided this study: To what extent was each of the explanatory constructs of TPB valid and reliable? Were the constructs independent? To what extent did the explanatory constructs in the TPB form a seven-factor structure? A sample of 184 from among educators in seven teacher training colleges (TTCs) in Tanzania responded to a questionnaire. Factor analysis, Cronbach alpha, and Pearson linear correlation were used for analysis. Hence, except the items of one construct (cbpfi), all the items of each of the remaining constructs were valid. However the constructs were highly inter-correlated. Lastly, only two constructs (PBC & cbpfi) were distinct. Hence the recommendation that researchers continue refining the explanatory constructs of the TPB.*

**Key words:** Reliability; Tanzania; Teacher training college; Theory of Planned Behaviour; Validity

### BACKGROUND

#### Theoretical Perspective

The Theory of Planned Behaviour (TPB) proposed by Ajzen (1991) shown in Figure 1, has actual behaviour (AB) as the main variable. Ajzen defined AB as an individual's observable response in a given situation with respect to a given target and that is a function of a given of compatible intentions and perceptions. According to Figure 1, TPB theorises that AB is predicted by both behavioural intention (BI) and perceived behavioural control (PBC). Ajzen defined BI as an indication of person's readiness to perform a given behaviour and PBC as the perceived ease or difficulty of performing the behaviour and is assumed to reflect past experience as well as anticipated impediments and obstacles. As per Figure 1, BI is in turn, predicted by attitude toward behaviour (ATB), subjective norm (SN) and PBC. Ajzen (1991) defined ATB as the degree to which a person has a favourable or unfavourable evaluation or appraisal of the behaviour in questions (e.g., using technology), and SN as the perceived social pressure to perform or not to perform the behaviour. Ajzen observes that "the more favourable the attitude and subjective norm with respect to a behaviour, and the greater the perceived behavioural control, the stronger should be an individual's intention to perform the behaviour under consideration" (p. 181).

The TPB (Figure 1) theorises that ATB is predicted by behavioural beliefs and outcome evaluations (bboe). Ajzen (1991) defined behavioural beliefs (bb) as an individual's subjective probability that performing the target behaviour will result in consequences, and outcome evaluation (oe) as rating of the desirability of the outcome. As per Figure 1.1, SN is predicted by normative beliefs and motivation to comply (nbmc). Ajzen defined normative beliefs (nb) as the likelihood that important individuals or group approve or disapprove of performing a given behaviour, and motivation to comply (mc) as the extent to which the person wants to comply with the wishes of the referent others. According to Figure 1, the TPB model posits that PBC is predicted by control beliefs and perceived facilitation (cbpf). Ajzen defined control beliefs (cb) as perception of the availability of skills, resources, and opportunities, and perceived facilitation (pf) as the individual's assessment of the importance of those resources to the achievement of outcomes. A recent meta-analysis (Riebl et al., 2015) of studies on TPB, ended by observing that, "few of the identified articles reported the validity and reliability of the... tools [based on TPB] and this needs attention in future" (p. 176). In response to this call, this study was intended to test the validity and reliability of TPB.

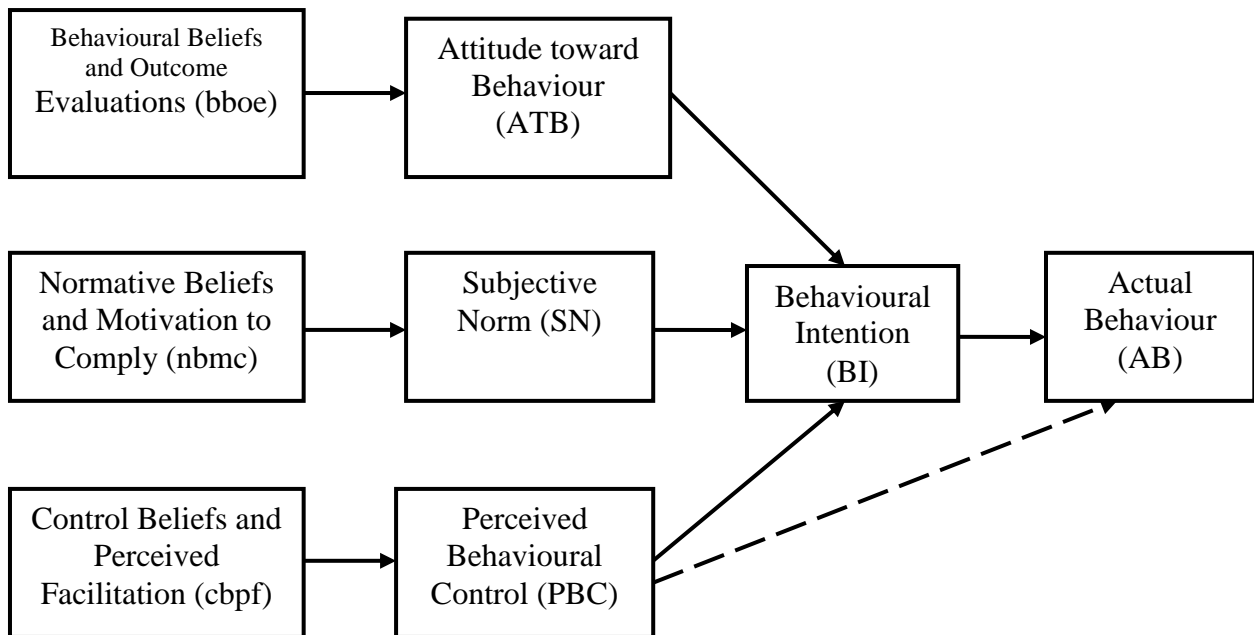


Figure 1: The Theory of Planned Behaviour (TPB)

Source: Ajzen, I. (1991). The Theory of Planned Behaviour. *Organizational Behaviour and Human Decision Processes*, 50, 179-211, page 182, Figure 1.

### Conceptual Perspective

Each construct in the Theory of Planned Behaviour, TPB (Figure 1) had to be operationalised. Hence the main variable, actual behaviour (AB) in this study referred to as the integration of ICT in teaching and learning (IITL). Behavioural intention (BI) in this study was defined as the intention to integrate ICT (II). Attitude toward the behaviour (ATB) in this study referred to the attitude toward integration of ICT (ATI). Subjective norm (SN) in this study referred to the subjective norm on the integration of ICT (SNI). Perceived behaviour control (PBC) referred to the perceived behaviour control on integration of ICT (PBCI). Another explanatory construct of TPB as per Figure 1, was behavioural beliefs and outcome evaluation (bboe) and in this study, was defined as the behavioural beliefs and outcome evaluation on the integration of ICT (bboei). Another explanatory construct in TPB is normative beliefs and motivation to comply (nbmc) and in this study, was defined as the normative beliefs and motivation to comply on the integration of ICT (nbmci). And finally, control beliefs and perceived facilitation (cbpf) in this study referred to the control beliefs and perceived facilitation on the integration of ICT (cbpfi).

### LITERATURE REVIEW

Several scholars have developed instruments for measuring the constructs of the Theory of Planned Behaviour (TPB) and have tested them for validity and reliability. Systematic literature reviews give good summaries on how the instruments on the constructs of TPB have been generally handled in such studies. For example, Riebel et al. (2015) carried out a meta-analysis "to determine... how the TPB has been applied to investigate dietary behaviours, and to evaluate which constructs are associated with dietary behavioral intentions and behaviors in youths" (p. 160). They identified 34 publications "by searching electronic databases, contacting experts in the field, and examining... internet-based TPB-specific bibliography" (p. 160). The studies that they reviewed had to have participants aged between two and 18 years, with the constructs of TPB discernibly measured and analysed. The articles had to have been published in peer-reviewed journals using English as their language. In their results section, they devoted a subsection (subsection 3.1) to what they termed, "Theory of Planned Behavior questionnaire development", wherein they critiqued the studies that they had reviewed for the flawed way in which they had developed and tested their instruments on TPB. They verbatim reported that of the studies reviewed.

Ten studies did not report conducting elicitation to develop questionnaire items.... Twenty nine articles describe[d] instrument pilot testing while six... [did] not.... Two studies refer[red] to prior work piloting the TPB measure..., and two studies piloted the measure, but not in the target population.... One study mentioned pretesting [the instruments on TPB but] without providing further details.... (pp. 163, 169).

There are also a few papers that are solely or mainly devoted to the development of instruments on the constructs of the TPB and testing them for validity and reliability. For example, Boyko, Lavis, Dobbins and Souza (2011) "developed a 15-item tool to measure four TPB constructs... and assessed its face validity through key informant interviews" (p. 1 of 7). The constructs of interest were behavioral intention, BI (three items), attitude toward the behavior, ATB (four items), subjective norm, SN (four items) and perceived behavioral control, PBC (four items). The items for each construct of TPB were scaled using the seven-point Likert scale. To test the reliability of the constructs, they used a sample of 62 policy-makers who participated in stakeholder dialogues. They hence tested the internal consistency of the respective constructs using Cronbach alpha and got the following satisfactory results: BI ( $\alpha = 0.89$ ); ATB ( $\alpha = 0.73$ ); SN ( $\alpha = 0.79$ ); and PBC ( $\alpha = 0.68$ ).

Francis et al. (2004) wrote a manual to guide health services researchers to develop questionnaires based on the TPB "in a systematic and replicable manner" (p. 7). They justified their effort by noting that TPB "can be useful in designing strategies to help people to adopt healthy behavior and to help clinicians [to] increase their uptake of guidelines" (p. 7). Apart from the first section (the introduction) which we have summarised so far, the manual has eight other sections. While the second section is devoted to a brief background to the theory (TPB), the third section gives the steps to follow when constructing a questionnaire based on TPB. While section four is on the measurement of behavioral intentions (BI), sections five through seven deal with how to measure three predictor constructs, namely attitude toward the behavior (ATB), subjective norm (SN) and perceived behavioral control (PBC). The eighth section suggests the "steps involved in managing the project, including how to construct the questionnaire as a whole" (p. 7). Finally, section nine outlines the recommended approaches to analysis.

Gonzalez, Lopez, Marcos and Rodriguez-Marin (2012) aimed at developing "a questionnaire based on TPB in [the] physical activity context, providing evidence for the validity of the obtained measures" (p. 801). They reported their results as a series of three independent studies. "The first study entailed the construction and qualitative assessment of the items" (p. 801). Then basing on the guidance of Francis et al. (2004) in constructing the instrument, they based their "qualitative evaluation" (p. 803) on the judgements from seven experts. In their second study, they analysed the factorial structure of the instrument using data that they had collected from 135 students enrolled in two degree programmes, namely Psychology and Sports Sciences at some university in Spain. In their second study, Gonzalez et al. "had the objective of selecting the final set of TPB questionnaire items for conducting physical exercise..." (p. 804). They grouped an initial set of 21 items that constituted the questionnaire into four subscales, namely intention to exercise, IE (four items); attitude toward exercise, ATE (eight items); subjective norms, SN (four items); and perceived behavioral control, PBC (five items). Using exploratory factor analysis (EFA), they extracted the four subscales, with the given number of items and Cronbach alphas ( $\alpha$ ) as follows: IE (all four items valid,  $\alpha = 0.89$ ); ATE (seven valid items of the eight original items,  $\alpha = 0.88$ ); SN (all four items valid,  $\alpha = 0.85$ ); and PBC (all five items valid,  $\alpha = 0.87$ ). "The third study provided evidence on the dimensionality of the scale" (p. 801). They hence used confirmatory factorial analysis (CFA) on data collected from a sample of "944 subjects from the general population who participated in the evaluation voluntarily" (p. 808) to guarantee the stability of the factorial structure proposed by the TPB. However, while they observed high correlations between the factors of IE, ATE and PBC, they found low relationships between all of them with SN.

Rueda, Moriano and Linan (2015) developed "an Entrepreneurial Intention Questionnaire (EIQ), based on an integration of psychology and entrepreneurial literature, as well as previous empirical research" (p. 61) in the field. Their research aimed "to establish the psychometric properties of the EIQ" (p. 64), inclusive of construct reliabilities and validities. They used the Theory of Planned Behaviour (TPB) "to understand and predict entrepreneurial intention" (p. 62). Hence, they developed what they termed a "TPB questionnaire" (p. 65) which comprised of four subscales: Entrepreneurial intention, EI (four items); attitudes toward entrepreneurship, ATE (six items); subjective norms, SN (six items), and perceived behavioral control, PBC (six items on entrepreneurial self-efficacy). The items for each construct of TPB were scaled using the seven-point Likert scale. Basing on data collected from 3,223 graduates from 15 universities in Spain, they used confirmatory factor analysis (CFA) to affirm that the items of all the constructs (except one for ATE) were valid. They also found the average variance extracted (AVE) "for each construct was satisfactory" (p. 69). Regarding composite reliability (CR), they confirmed that all the constructs "exceeded the minimum requirements" (p. 69). Finally, using Pearson's correlation coefficients (PLCC), they found that all the constructs were "positively correlated... in line with previous studies" (p. 70).

However, apart from some of these resources (e.g. Francis et al., 2004) being dated, even these papers solely or mainly devoted to the cause of designing instruments on the constructs of TPB, ignored the indirect explanatory constructs of TPB namely the behavioral beliefs and outcome evaluations (bboe), normative beliefs and motivation to comply (nbmc), and control beliefs and perceived facilitation (cbpf). The present study reduced those gaps by considering those otherwise ignored constructs of TPB too. The research questions posed for this study were:

1. To what extent were each of the seven explanatory constructs of TPB valid and reliable?
2. To what extent were the seven explanatory constructs of TPB independent?
3. To what extent were the explanatory constructs of TPB forming a seven-factor structure?

## METHODOLOGY

### Instrument

Data were collected using an instrument compiled using parts of existing instruments already used by other researchers. The number of items adapted from a given instrument and its reliabilities ( $\alpha$  values) are given in Table 1. As its structure in Table 1 shows, the instrument contained 32 items for measuring the explanatory constructs of the TPB. Of these, three items were on II, four items on ATI, two items on SNI, three items on PBCI and six items on each of bboei, nbmci and cbpfi respectively. The items were scaled using the five-point Likert scale from a minimum of 1 (for strongly disagree) to a maximum of 5 (for strongly agree).

**Table 1: The Study Instrument**

Construct	Number of items adapted	Source of instrument, number of items and their reliability ( $\alpha$ value)
II	2	Taylor & Todd (1995), 3 items ( $\alpha = 0.91$ )
	1	Not applicable
ATI	4	Taylor & Todd (1995), 4 items ( $\alpha = 0.85$ )
SNI	2	Teo & Lee (2010), 2 items ( $\alpha = 0.91$ )
PBCI	3	Fusilier & Durlabhji (2005), 3 items ( $\alpha = 0.80$ )
bboei	5	Apeanti (2014) 15 items*
	1	Not applicable
nbmci	4	Taylor & Todd (1995), 8 items ( $\alpha = 0.92$ )
	2	Not applicable
cbpfi	4	Taylor & Todd (1995), 18 items ( $\alpha = 0.78$ )
	1	Thompson, Higgins & Howell (1991), 4 items ( $\alpha = 0.86$ )
	1	Lumpe & Chambers (2001), 13 items*

\* No reliability ( $\alpha$  value) reported

### Sample

The sample comprised of 184 of 390 educators from seven public teacher training colleges (TTCs) in Tanzania. The seven public TTCs were Butimba, Kleruu, Monduli, Morogoro, Mpwapwa, Mtwara and Tabora. The males (63.0%) dominated the sample compared to the females (37.0%). The majority (64.1%) of the respondents were aged 30 but below 40 years as compared to those (31.0%) who were aged 40 years and above and those (04.9%) aged below 30 years. Thus, the majority of the respondents were middle aged. When it came to teaching experience at college level, the majority (55.4%) of the respondents had served for between five and 10 years as compared to those (34.2%) that had served for more than ten years and others (10.3%) that had served for up to five years. Almost all (94.5%) the respondents were equally divided among those with a bachelor's degree (47.8%) and those with a Masters degree (46.7%) as their highest level of education, with very few holding a postgraduate (3.8%) or undergraduate (1.6%) diploma.

The respondents were almost equally distributed to the seven TTCs, as follows in descending order: Kleruu (16.8%), Morogoro (15.2%), Butimba and Monduli (each 14.7%), Tabora (14.1%), Mpwapwa (13.0%) and Mtwara (11.4%). In terms of areas of specialisation, the modal category 38.6% was that of the Sciences; followed by the Social Sciences or Humanities (33.7%) and Education (27.7%). Regarding terms of employment, all (i.e. 100%) of the respondents were permanent and pensionable; and none in the other categories of Probation; Part-time; and Contract. In terms of position in a given college, the majority (54.9%) were purely academic as opposed to 45.1% who held administrative responsibilities. With respect to academic rank, the modal category (49.5%) of the respondents were senior tutors; followed by tutors (39.7%); principal tutors (9.8%); and assistant tutors (1.1%).

## DATA ANALYSIS

The validities of the explanatory constructs of the TPB (i.e. II; ATI, SN, PBCI; bboei, nbmci & cbpfi) were tested using confirmatory factor analysis (CFA), while their reliabilities were tested using Cronbach's alpha method. Pearson linear correlation (PLC) analysis was carried out to establish whether the explanatory constructs of TPB were independent. Whether the explanatory constructs of the TPB formed a seven-factor structure was tested using exploratory factor analysis (EFA).

## RESULTS

### Research Question 1. To What Extent was each of the Seven Explanatory Constructs of TPB, Valid and Reliable?

The first question in this study was, to what extent was each of the explanatory constructs (II, ATI, SNI, PBCI, bboei, nbmci & cbpfi) of the TPB, valid and reliable? This was answered using confirmatory factor analysis (CFA) and Cronbach alpha method. Factors with eigenvalues greater than one (Kahn, 2006) were considered significant. For a given factor loading, a benchmark of 0.5 (Matsunaga, 2010) was used as the minimum while for reliability test, a benchmark of  $\alpha = 0.7$  (Gliem & Gliem, 2003) was used as the minimum. The results of CFA and Cronbach alpha of each of the explanatory constructs are as presented in Tables 2-8.

#### Intention to Integrate ICT (II)

According to Table 2, CFA reduced the three items on II to one factor. The factor had an eigenvalue of 2.047, meaning that the factor accounted for  $2.047/3 \times 100 = 68.23\%$  of the total variance among the three items. The loadings of the items on the factor are also given in Table 2. Given loadings of 0.5 as being high (Matsunaga, 2010), the three items (II 1 - II 3) loaded highly on the factor which meant that all the three items in Table 2, validly measured II. Cronbach's alpha for the three items was 0.712 which was greater than the benchmark of 0.7 (Gliem & Gliem, 2003), indicated that the items were also reliable measures of II.

**Table 2: Loadings and Cronbach Alpha on the Factor on Intention to Integrate ICT (II)**

Item*	Description	Factor Loadings	Cronbach $\alpha$
II 1	I need not be pushed to integrate ICT in my teaching and learning	0.637	0.712
II 2	I intend to integrate ICT in my teaching and learning as often as possible	0.908	
II 3	I intend to integrate ICT in my future teaching and learning assignments	0.904	
Eigenvalue		2.047	
% variation explained		68.230	

\*All items were valid

#### Attitude toward Integration of ICT (ATI)

Results in Table 3, indicate that CFA reduced the four items on ATI to only one factor. The factor had an eigenvalue of 3.276, meaning that the factor accounted for  $3.276/4 \times 100 = 81.91\%$  of the total variance among the four items. The loadings of the items on the factor are also given in Table 3. Considering loadings of at least 0.5 as being high (Matsunaga, 2010), all the four items (ATI 1 - ATI 4) loaded highly on the factor which meant that all the four items in Table 3, validly measured ATI. Cronbach's alpha of the four items was 0.925, which was greater than the 0.7 benchmark (Gliem & Gliem, 2003), suggested that the items were also reliable measures of ATI.

**Table 3: Loadings and Cronbach Alpha on the Factor on Attitude toward Integration (ATI)**

Item*	Description	Factor Loadings	Cronbach $\alpha$
ATI 1	I feel that integration of ICT in my teaching and learning is a good idea	0.919	0.925
ATI 2	I feel that teaching and learning using ICT is appropriate	0.901	
ATI 3	I like integrating ICT in my teaching and learning	0.916	
ATI 4	I find using ICT in my teaching and learning to be enjoyable	0.884	
Eigenvalue		3.276	
% variation explained		81.910	

\*All items were valid

#### Subjective Norm on Integration of ICT (SNI)

Table 4 indicates that after performing CFA, the two items on SNI were reduced to one factor. The factor had an eigenvalue of 1.762, meaning that the factor accounted for  $1.762/2 \times 100 = 88.1\%$  of the total variance between the two items. The loadings of the items on the factor are also given in Table 4. Considering loadings of at least 0.5 as being high (Matsunaga, 2010), both items (SNI1 & SNI2) loaded highly on the factor which meant that both items in Table 4, validly measured SNI. The reliability of these two items was 0.865 which was high than the 0.7 benchmark (Gliem & Gliem, 2003), implied that both items were also reliable measures of SNI.

**Table 4: Loadings and Cronbach Alpha on Factor on Subjective Norm on Integration (SNI)**

Item*	Description	Factor Loadings	Cronbach $\alpha$
SNI 1	People who influence my behaviour think that I should integrate ICT in my teaching and learning	0.939	0.865
SNI 2	People who are important to me think that I should integrate ICT in my teaching and learning practices	0.939	
Eigenvalue		1.762	
% variation explained		88.102	

\*Both items were valid

#### Perceived Behavioural Control on Integration of ICT (PBCI)

According to Table 5, CFA reduced the three items on PBCI, to one factor. The factor had eigenvalue of 2.292, meaning that the factor accounted for  $2.292/3 \times 10 = 76.4\%$  of the total variance among the three items. The loadings of the items on the factor are also given in Table 5. Considering loadings of at least 0.5 as being high (Matsunaga, 2010), all the three items (PBCI 1 - PBCI 3) loaded highly on the factor which meant that all the three items in Table 5, validly measured PBCI. The reliability of these three items was 0.842 which was greater than the 0.7 benchmark (Gliem & Gliem, 2003), suggested that the items were also reliable measures of PBCI.

**Table 5: Loadings and Cronbach Alpha on the Factor on Perceived Behavioural Control on Integration of ICT (PBCI)**

Item*	Description	Factor Loadings	Cronbach $\alpha$
PBCI 1	I am capable of integrating ICT in my teaching and learning	0.888	0.842
PBCI 2	I have the resources, knowledge and skills to integrate ICT effectively in my teaching and learning practices	0.842	
PBCI 3	I am able to integrate ICT in my teaching and learning practices if I want to do so	0.891	
Eigenvalue		2.292	
% variation explained		76.399	

\*All items were valid

#### Behavioural Beliefs and Outcome Evaluation on Integration of ICT (bboei)

Table 6 shows that the CFA reduced the six items on bboei to one factor. The factor had eigenvalue of 4.232, meaning that the factor accounted for  $4.232/6 \times 100 = 70.5\%$  of the total variance among the six items. The loadings of the items on the factor are also given in Table 6. Considering factor loadings of 0.5 as being high (Matsunaga, 2010), all the six items (bboei1 - bboei6) loaded highly on the factor which meant that all the six items in Table 6, validly measured bboei. This set of items had Cronbach alpha of 0.912, which was greater than the 0.7 benchmark (Gliem & Gliem, 2003), suggested that the items were also reliable measures of bboei.

**Table 6: Loadings and Cronbach Alpha on the Factor on Behavioural beliefs and Outcome Evaluation on Integration (bboei)**

Item*	Description	Factor Loadings	Cronbach $\alpha$
bboei1	When integrating ICT in my teaching and learning, I will be able to tailor my students' work to their individual needs	0.767	0.912
bboei2	If I integrate ICT in my teaching and learning, my students will be motivated to engage in a variety of learning tasks	0.898	
bboei3	I believe that integrating ICT in my teaching and learning would enable me to interact more with my students	0.843	
bboei4	Integrating ICT in teaching and learning is not time consuming to me	0.755	
bboei5	I believe that by integrating ICT in my teaching and learning, I am helping my students to acquire the basic computer skills needed in their future teaching and learning	0.895	
bboei6	Integration of ICT in my teaching and learning practices promotes collaboration and self-directed learning among my learners	0.870	
Eigenvalue		4.232	
% variation explained		70.536	

\*All items were valid.

### Normative Beliefs and Motivation to Comply on Integration of ICT (nbmci)

According to Table 7 the CFA generated one factor out of the six items which had an eigenvalue of 4.082. This means that the factor accounted for  $4.082/6 \times 100 = 68.03\%$  of the total variance among the four items. The loadings of the items on the factor are also given in Table 7. Considering loadings of at least 0.5 to be high (Matsunaga, 2010), all the six items (nbmci1 - nbmci6) loaded highly on the factor which meant that all the six items in Table 7, validly measured nbmci. The high Cronbach's alpha of 0.904 which was greater than the 0.7 benchmark (Gliem & Gliem, 2003), suggested that they were also reliable measures of nbmci.

**Table 7: Loadings and Cronbach Alpha on the Factor on Normative Beliefs and Motivation to Comply on Integration of ICT (nbmci)**

Item*	Description	Factor Loadings	Cronbach $\alpha$
nbmci1	The College Management (e.g. Principal, Academic Dean, heads of department) think that I should integrate ICT in my teaching and learning activities	0.851	0.904
nbmci2	My colleagues (e.g. fellow teacher educators) think that I should integrate ICT in my teaching and learning	0.802	
nbmci3	My students expect me to integrate ICT in my teaching and learning practices	0.840	
nbmci4	I want to do what the College Management think I should do with respect to integration of ICT in teaching and learning	0.816	
nbmci5	I want to do what my colleagues think I should do in regard to integration of ICT in teaching and learning	0.836	
nbmci6	I want to do what my students expect of me in respect to integration of ICT in teaching and learning	0.802	
Eigenvalue		4.082	
% variation explained		68.028	

\*All items were valid

### Control Beliefs and Perceived Facilitation on Integration of ICT (cbpfi)

The results in Table 8 indicate that the CFA reduced the six items on bboei to two factors. The two factors had eigenvalues of 2.868 and 1.343, meaning that the factors accounted for  $2.868/6 \times 100 = 47.80\%$ , and  $1.343/6 \times 100 = 22.38\%$  of the total variance among the six items. The loadings of the items on the factors are also given in Table 8 after Varimax rotation (Yong & Pearce, 2013). Considering loadings of at least 0.5 as being high (Matsunaga, 2010), then according to Table 8, only three items (cbpfi1 - cbpfi3) loaded highly on the first factor, which meant that these three items were the most valid measures of cbpfi. The other items (cbpfi4 - cbpfi6) loaded highly on the second factor. The Cronbach alpha for the most valid items was 0.799, which was greater than the 0.7 benchmark (Gliem & Gliem, 2003), suggested that they were also reliable measures of cbpfi.

**Table 8: Loading and Cronbach Alpha on the Factors on Control Beliefs and Perceived Facilitation on Integration of ICT (cbpfi)**

Item	Description	Loadings		Cronbach $\alpha$
		Factor 1	Factor 2	
cbpfi1*	I feel comfortable integrating ICT in teaching and learning on my own	0.882		0.799
cbpfi2*	If I want to, I can easily integrate any of the ICT equipment available in my College for teaching and learning purposes	0.802		
cbpfi3*	I am capable of selecting and using ICT tools in my teaching and learning activities	0.798		
cbpfi4	There are enough resources (e.g. computers, Internet, projector, pedagogical software) in my College for me to integrate ICT in teaching and learning		0.781	
cbpfi5	There is a technical person or group available in my College to assist me with hardware and software difficulties whenever I need help with regard to teaching and learning		0.759	
cbmci6	There are opportunities available in my College for my professional development in matters related to integration of ICT in teaching and learning		0.861	
Eigenvalue		2.868	47.802	
% variation explained		1.343	22.380	

### Research Question 2. To What Extent Were the Seven Explanatory Constructs of TPB, Independent?

The second question in this study was, were the explanatory constructs of the TPB (i.e., II, ATI, SNI, PBCI, bboei, nbmci & cbpfi) independent? Hence, average indexes were computed for the valid items of the respective constructs. The correlations given in Table 9 indicate that all the explanatory constructs of the TPB were highly inter-correlated ( $p < 0.01$  for all pairs). Regarding magnitudes, the highest correlation was between bboei and ATI ( $r = 0.784$ ) and the smallest between PBCI and II ( $r = 0.358$ ).

**Table 9: Correlations between the Constructs of TPB**

TPB constructs	II	ATI	SNI	PBCI	Bboei	nbmci	cbpfi
II							
ATI	0.732**						
SNI	0.520**	0.590**					
PBCI	0.358**	0.501**	0.394**				
Bboei	0.643**	0.784**	0.580**	0.643**			
Nbmci	0.480**	0.622**	0.680**	0.501**	0.707**		
Cbpfi	0.505**	0.652**	0.560**	0.698**	0.711**	0.630**	

\*\*Correlation is significant at 0.01 level

### Research Question 3: To What Extent Were the Explanatory Constructs in the TPB Framework Forming a Seven-Factor Structure?

The third and last question in this study was, to what extent the explanatory constructs of the TPB framework, forming seven-factor structure? Exploratory factor analysis (EFA) reduced the 32 explanatory items in the TPB instrument (Tables 2-8) into as many factors. However, as Table 10 suggests, only the first four factors were significant since they had eigenvalues ranging from 14.0 (maximum) to 1.4 (minimum) that exceeded 1.00. These factors explained from 46.7% (maximum) to 4.7% (minimum) respectively of the joint variation in the 32 items. The items with high factor loadings (of at least 0.5) are given in Table 10 after a Varimax rotation, as recommended by Yong and Pearce (2013, pp. 84, 86). The question was: Were the seven explanatory constructs in the TPB framework as suggested by Ajzen (1991) discernible in Table 10?

Table 10 suggests that the constructs of the intention to integrate ICT, II (II 1-II 3); and all those of attitude towards integration, ATI (ATI 1-ATI 4); and three of those on behavioral beliefs and outcome evaluation on integration, bboei (bboei3, bboei5, bboei6) and only one item on control beliefs and perceived facilitation on integration, cbpfi (cbpfi1) loaded together on the first and hence most significant factor as its valid items. This suggested that the constructs II, ATI and to an extent bboei were not distinct. The two items of the constructs of social norms, SNI (SN1 & SN2); and all those of the construct on normative beliefs and motivation to comply on integration, nbmci (nbmci1 - nbmci6) loaded together on the second and hence second most significant factor as its valid items. This suggested that the constructs SNI and nbmci were not distinct. The third and fourth factors in descending order of importance, were dominated by the constructs of perceived behavioral control (PBC) and cbpfi respectively. In summary, only a four-factor structure of the explanatory constructs of TPB - and not a seven-factor structure as suggested by Ajzen (1991) - could be discerned in Table 10.

**Table 10 Factors, their eigenvalues, % variance explained and highly loading items**

Factor	Eigenvalue	% variance	Highly loading items (loading in brackets)
1	14.0	46.7	II 1 (0.588); II 2 (0.757); II 3 (0.804); ATI (0.809); ATI2 (0.781); ATI3 (0.769); ATI4 (0.665); bboei2 (0.671); bboei3 (0.565); bboei5 (0.563); bboei6 (0.563); cbpfi1 (0.515)
2	2.5	8.4	SN1 (0.608); SN2 (0.645); nbmci1 (0.783); nbmci2 (0.715); nbmci3 (0.764); nbmci4 (0.697); nbmci5 (0.758); nbmci6 (0.744)
3	1.8	6.0	PBC1 (0.774); PBC2 (0.749); PBC3 (0.840); bboei1 (0.536); cbpfi3 (0.726)
4	1.4	4.7	Cbpfi4 (0.784); cbpfi5 (0.783); cbpfi6 (0.784)

## DISCUSSION

The first question in this study was, to what extent was each of the explanatory constructs of the TPB, valid and reliable? Confirmatory factor analysis (CFA) and Cronbach alpha revealed that all the items of each of the constructs II through nbmci were valid and reliable measures of their respective constructs. However, for the construct cbpfi only three of the six items were valid and reliable measures. The results (Tables 2-8) to the effect that the items of almost all the constructs being valid and reliable, was similar to that of several studies (e.g. Gonzalez et al., 2012; Rueda et al., 2015), where CFA tended to support the validity of each construct of TPB that they had used. In this regard, the finding based on CFA implied that the explanatory constructs of TPB are a reasonable framework which researchers should continue using with confidence.

The second question in this study was, to what extent were the explanatory constructs of the TPB (II, ATI, SNI, PBCI, bboei, nbmci & cbpfi) independent? The results of correlation analysis (Table 9), suggested that all the explanatory constructs of TPB were highly inter-correlated. This result which was similar to that of several earlier studies (e.g. Gonzalez et al., 2012; Rueda et al., 2015) implied that the explanatory constructs of TPB did not really measure different things. In other words it implies that when carrying out a multiple linear regression involving at least two of the constructs as explanatory variables, the researcher does not have to include all of them. Else the model may suffer what is known as multi-collinearity (Sweet & Grace-Martin, 2003).

The third and last question in this study was, to what extent did the explanatory variables (II, ATI, SNI, PBCI, bboei, nbmci & cbpfi) in the TPB framework make up a seven-factor structure? Exploratory factor analysis, EFA (Table 10) suggested that only a four-factor structure could be obtained using our data set. II, ATI and to an extent bboei loaded together and hence were not distinct constructs. The constructs SN and nbmci also loaded together and hence were not distinct constructs. PBC and cbpfi were the only distinct constructs. The finding concurred with the usual trend where CFA tends to support the factorial structure of such models as the TPB (e.g. in this very paper, see Gonzalez et al., 2012; Rueda et al., 2015) and the Technological Pedagogical Content Knowledge (TPACK) framework (e.g. see Batiibwe, Bakkabulindi & Mango, 2016), while EFA tends not to do so (e.g. see Batiibwe et al., 2016 for TPACK). This is a real conundrum for researchers because, as Chai, Ng, Li, Hong and Koh (2013) suggest, EFA is a more powerful tool than CFA. If "factor analysis was conducted one factor at a time, the rigour of the factor analysis [i.e., CFA] is questionable" (Chai et al., 2013, p.43). Another question is, which of CFA and EFA should come first? Wei, Sadikova, Barnard-Brak, Wang and Sodikov (2015, pp. 6, 9) seem to suggest that EFA should precede CFA, when they contend that EFA "is typically used earlier in the process of instrument development to determine the appropriate number of common factors" (p. 6). But in our case, if we had started with EFA and got the four factors in Table 10, would we then be testing the real TPB with seven explanatory variables as given in Figure 1? Not at all! These dilemmas are food for thought for future researchers to resolve.

### CONCLUSIONS AND RECOMMENDATIONS

This study made an attempt to develop and establish the validity and reliability of an instrument assessing the explanatory constructs of TPB among educators in public teacher training colleges (TTCs) in Tanzania. The constructs of TPB were intention to integrate ICT (II); attitude toward integration of ICT (ATI); subjective norm on integration of ICT (SNI); and perceived behavioural control on integration of ICT (PBCI). Others were behavioural beliefs and outcome evaluation on integration of ICT (bboei); normative beliefs and motivation to comply on integration of ICT (nbmci); and control beliefs and perceived facilitation on integration (cbpfi). Confirmatory factor analyses (CFA) indicated that except the items on the construct cbpfi, all the items of each of the other explanatory constructs of TPB (II, ATI, SNI, PBCI, bboei & nbmci) were valid measures of their respective constructs. Pearson linear correlation (PLC) suggested however, that the constructs of the TPB were highly inter-correlated. Exploratory factor analysis (EFA) revealed that the constructs of II, ATI and bboei loaded together; the same obtained to the two constructs SNI and nbmci. Only two constructs (PBC & cbpfi in that order of importance) were distinct. It was recommended that researchers should continue testing the validity and reliability of the explanatory constructs of the TPB framework in order to refine them since they were found not to be perfect. The study had limitations, an obvious one relating to the sample scope limited to seven public TTCs. Related studies should be carried out in other TTCs in Tanzania, inclusive of private ones. The studies could even be extended to other institutions than TTCs.

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