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Measurement of tacit knowledge and its conversion to explicit knowledge: a case study of Bolpur college library

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A questionnaire survey was conducted to collect user feedback on various elements of library administration as well as users' expectations to improve library services. A construct model has been deduced using exploratory factor analysis (EFA) by identifying optimal number of significant factors. The proposed construct has been validated by using structural equation modeling (SEM) in terms of convergent and discriminant validities. The proposed framework has been implemented on a survey of the users of Bolpur college library. The results indicate effectiveness in analyzing the TK and its conversion to explicit knowledge and has been proven to be a positive step towards improvement of library services.

Keywords: Tacit knowledge, Explicit knowledge, Exploratory Factor Analysis, Structural Equation Modeling

Introduction

Owing to its distinctiveness and significant contributions to organizational performance, tacit knowledge (TK) has gained increasing attention and acceptance in the field of knowledge management[1]. TK can be largely attributed to personal experience, intuition and point of view or obtained from internal personalized processes[2,3]. It is that kind of knowledge which works in the idea plane and aids in the expression of one's uniqueness[4,5]. This kind of knowledge mainly depends on culture, habit, beliefs, ideals, values, and mental models which are deeply ingrained in us and which we often assume as implicit[6]. As a result of this, the 'modes of thinking', 'ability to handle', or the 'ability to interpret' may differ from person to person. Some examples of tacit knowledge are riding bicycle, playing flute, driving a car, and retrieving books from the shelves without knowledge of call numbers. Thus, TK is unconsciously used by people in their daily lives, but it cannot be easily articulated, verbalized, or noted down.

On the other hand, explicit knowledge is what we can communicate easily to others in written or verbal or visual form. It can easily be stored, retrieved, and disseminated as and when needed. TK on the other hand, is part of informal learning component. Thus, to bridge the gap, tacit knowledge is molded and reshaped into explicit knowledge for the purpose of exchanging ideas and feelings in a concrete manner. Both concepts are interlinked with each other but the conversion of knowledge from an individual's mental model or perception to an explicit outcome of knowledge both in verbal and written form is sometimes affected by influencing factors inherent within our societal structure.

In the changing academic environment where online library services play a very significant role, quantifying tacit knowledge of library users is of paramount importance. Explicit knowledge is generated within library in the form of memo guidelines, thesis, reports, books, journals etc. Tacit knowledge being an unarticulated knowledge resides in senior and experienced employees with a sound knowledge of work procedures, rules and regulations[7]. Moreover, as traditional face-to-face interaction is not the norm as was in the past, recognizing the needs of users becomes increasingly difficult. Since most of the user requirements are in electronic format, a structured framework for interpreting tacit knowledge is essential for libraries to remain competitive[8].

Despite the crucial role of TK in knowledge management, study on the subject is frequently overlooked due to measurement difficulties[9,10]. This

poses a significant challenge to the organizations in terms of capturing both human knowledge and experience in order to improve existing offerings[11]. In library information systems, TK is not a very new concept but it is in more of subjective nature to understand the TK—for example understanding TK by storytelling approach[12].

A library personnel may possess sound knowledge and experience in library services, but while responding to users' queries, they try to understand many factors about the library user like the requirements of the user, context, environment, and so on. It is often assumed that TK has an unconscious character, from the point of view of individual use. At the library, when a user is not able to properly articulate requirements such as the title and author of the book and asks for it by mentioning the color of the cover, the user's ability to describe the book becomes important to the library personnel. Librarians often deal with users who don't properly express their requirements in a structured way which become an impediment for the library personnel to serve the user.

On the other hand, there are differently abled people who express their requirement through non-verbal means including sign language. So, it is mostly a challenge for a library personnel to decipher these users' requests and serve them accordingly.

The present work will throw light on these perspectives and discuss a framework for construct development to measure the TK and test the same for construct validation. An Exploratory Factor Analysis (EFA) is used for finding out the significant factors of the identified measures that have been taken from the existing literature on TK. Post construct development, Structural Equation Modeling (SEM) has been utilized to validate the identified constructs deduced by EFA.

This work aims at providing a better interpretation and understanding the interrelationship of the factors that might improve user services of a college library.

Objectives of the study

- To measure the TK of the users of a college library by identifying the latent factors and combining the indicators of TK which affect in the conversion of tacit knowledge to explicit knowledge using exploratory factor analysis; and
- To validate the identified influencing factors in terms of construct validity using structural equation modeling.

Methods

The Bolpur College was established in 1950. Currently, there are 3262 library users belonging to different schools of studies. The college library has 39,928 books and 26 print journals. The library also has e-resources through N-LIST membership.

Through random sampling, 300 users were invited to participate in this study, of which 250 were interested in taking part in the 17-question survey. Two hundred and ten responses were found to be complete. The responses were collected on a Likert Scale of 1-7 (Figure 1) with 1 and 7 as least and most preferred respectively.

Analysis

Sample adequacy measurement

Prior to the analyses, normality of the response data, was tested using Shapiro-Wilks test and Mardia test for univariate and multivariate normality respectively. In both tests it fails to satisfy normality (all $p < 0.01$) requiring Principal Axis Factoring (PAF) method of factor extraction to be adopted instead of Principal Components Analysis (PCA) method. Next, the sample adequacy measurement is tested using Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy (MSA). KMO statistic is found to be 0.86 with $p < 0.01$, proving to be significant[13,14]. For testing significance of correlation between items and guaranteeing the correlation matrix, a non-identity matrix Bartlett's sphericity test is carried out with statistic $\chi^2(136) = 2071.85$, $p < .001$ indicating the applicability of Factor Analysis.

Exploratory factor analysis

For carrying out EFA, as the collected data fails to satisfy normality assumptions, Principal Axis Factoring (PAF) is adopted[15]. An EFA is carried out

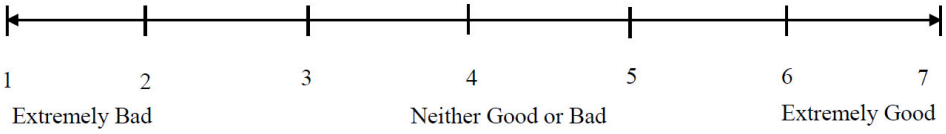

Fig. 1 — Sample of Likert Scale used to collect the responses

to extract the optimal number of factors observing the eigen values with values > 1 as eigen values <1 depict that the corresponding factors don't consider even a single item[16]. So, using Kaiser criterion, 2 factors are chosen (Table 1). Along with this, a scree plot shows effective number of factors to be extracted as 2 as all other factors are having eigen values below 1 (Figure 2).

The recommended rotation method is oblimin[17]. So, the EFA is run for 2 factors and the standardized loadings matrix (pattern matrix) is generated in Table 2.

Based on the last column i.e. complexities or cross loadings of the items it is seen that Q5, Q13 and Q14 are having values near 2 which should be below 1.4, giving strong evidence of removing those items from our study[18]. Moreover, based on this removal of items it is clear that all the factor loadings are more than 0.5 which is an indication of significant practicality[16]. Along with this, the correlation between the factors is 0.209 which is well below 0.85 to be a measure of no overlapping between the factors[15]. After removal of the items with high cross loading and low factor loadings the EFA is executed again to produce the final EFA model. In Table 3, Q17 is seen with cross loading 1.45 crossing 1.4 and the Factor Loading is also below 0.5 so, it is discarded from the list and the EFA is run again.

In Table 4, the optimal set of factors are found with values of cross loadings and factor loadings all satisfied. So, finally by EFA, Factor 1 is set to combine the items Q1, Q2, Q3, Q4, Q6, Q9, Q10, Q11 and Q16. Rest four items Q7, Q8, Q12 and Q15 are combined in Factor 2. To determine the internal consistency reliability of the factors extracted in the EFA the Cronbach's Alpha is calculated to be 0.886 for both of the factors which is considered to be 'Very Good' in terms of internal consistency checking[19].

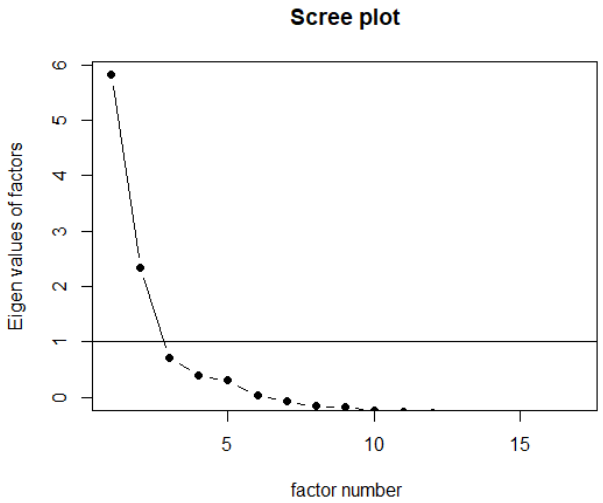

Fig. 2 — Scree plot criterion to select best number of factors

Table 1 — Extracted factors based on Eigen value computation by Kaiser criterion

Variable to be measured	Factors	Eigenvalue (Kaiser Criterion)	Decision
TK	Factor1	5.82	Accept
	Factor2	2.33	Accept
	Factor3	0.71 and so on	Reject

Table 2 — Step 1 of finding optimal number of factors and possible deletion of items

	Factor 1	Factor 2	Communalities	U2	Complexities
Q1	0.663	<0.3	0.429	0.571	1.01
Q2	0.807	<0.3	0.63	0.37	1.2
Q3	0.738	<0.3	0.521	0.479	1.09
Q4	0.703	<0.3	0.609	0.391	1.2
Q5	0.514	0.419	0.529	0.471	1.92
Q6	0.591	<0.3	0.368	0.632	1.02
Q7	<0.3	0.842	0.716	0.284	1
Q8	<0.3	0.845	0.706	0.294	1
Q9	0.66	<0.3	0.44	0.56	1
Q10	0.686	<0.3	0.529	0.471	1.08
Q11	0.589	<0.3	0.468	0.532	1.34
Q12	<0.3	0.669	0.448	0.552	1
Q13	0.424	<0.3	0.306	0.694	1.72
Q14	0.398	0.474	0.462	0.538	1.94
Q15	<0.3	0.875	0.747	0.253	1.01
Q16	0.691	<0.3	0.458	0.542	1.13
Q17	0.453	<0.3	0.283	0.717	1.37
Variance Explained	0.302	0.207			

Table 3 — Step 2 of finding optimal number of factors and possible deletion of items

	Factor 1	Factor 2	Communalities	U2	Complexities
Q1	0.665	<0.3	0.44	0.56	1
Q2	0.803	<0.3	0.639	0.361	1.15
Q3	0.73	<0.3	0.521	0.479	1.06
Q4	0.704	<0.3	0.611	0.389	1.24
Q6	0.591	<0.3	0.373	0.627	1.05
Q7	<0.3	0.855	0.742	0.258	1
Q8	<0.3	0.866	0.752	0.248	1
Q9	0.642	<0.3	0.418	0.582	1
Q10	0.685	<0.3	0.532	0.468	1.12
Q11	0.566	<0.3	0.416	0.584	1.34
Q12	<0.3	0.647	0.42	0.58	1
Q15	<0.3	0.866	0.742	0.258	1
Q16	0.696	<0.3	0.475	0.525	1.08
Q17	0.461	<0.3	0.294	0.706	1.45
Variance Explained	0.314	0.212			

Table 4 — Step 3 of finding optimal number of factors and possible deletion of items

	Factor 1	Factor 2	Communalities	U2	Complexities
Q1	0.671	<0.3	0.451	0.549	1
Q2	0.824	<0.3	0.672	0.328	1.12
Q3	0.738	<0.3	0.534	0.466	1.05
Q4	0.704	<0.3	0.614	0.386	1.27
Q6	0.606	<0.3	0.398	0.602	1.06
Q7	<0.3	0.872	0.774	0.226	1.01
Q8	<0.3	0.865	0.749	0.251	1
Q9	0.639	<0.3	0.416	0.584	1.01
Q10	0.673	<0.3	0.517	0.483	1.13
Q11	0.547	<0.3	0.39	0.61	1.36
Q12	<0.3	0.646	0.417	0.583	1
Q15	<0.3	0.857	0.725	0.275	1.01
Q16	0.661	<0.3	0.43	0.57	1.09
Variance Explained	0.320	0.225			

Construct validation using PLS-SEM

Based on the findings of the EFA to further validate the model based on the EFA findings and the SEM based on Partial Least Squares is carried out. SEM Comprises two simultaneously assessed interrelated models namely, Measurement Model referring to the relationships between observed variables and the latent factors and Structural Model referring to the relationship among the latent factors.

The Measurement Model is given as following:

Factor1 = Q1+ Q2+ Q3+ Q4+ Q6 + Q9+ Q10 + Q16
Factor2 = Q7 + Q8 + Q12 + Q15

Assessment of measurement model

The measurement model is evaluated to test the validity and reliability of the measurement items with all the constructs as reflective type. Examining two types of validities namely, convergent validity and discriminant validity, the measurement model is assessed based on the results of the EFA.

Convergent validity is assessed based on factor loadings (FL), composite reliability (CR), average variance explained (AVE) and internal consistency reliability (ICR). The FLs should be more than 0.70 and statistically significant at 0.05 significance level to ensure the model fit[20]. In Table 5, all the indicator loadings are well above the suggested value, and all are statistically significant. The average variance explained must be more than 0.5 which depicts the overall amount of variance in the indicators accounted for by the latent construct[21].

In Table 6, all the AVE values are found to be well above the recommended value[16,20]. Next, the Composite Reliability (CR) reflects the degree to which the construct indicators show the latent construct, must exceed the recommended level of 0.70 or higher[16]. In Table 6, the reported CRs are found to

Table 5 — Indicator loading and statistical significance testing

Factor-Indicator Pair	FL	t-stat	Significant at α= 0.05 (1.96) and α= 0.01 (2.58)
F1-Q1	0.733	16.65	Yes
F1-Q2	0.817	36.63	Yes
F1-Q3	0.764	24.33	Yes
F1-Q4	0.775	21.46	Yes
F1-Q6	0.745	14.08	Yes
F1-Q9	0.716	13.49	Yes
F1-Q10	0.729	17.44	Yes
F1-Q16	0.723	16.57	Yes
F2-Q7	0.901	69.30	Yes
F2-Q8	0.896	57.43	Yes
F2-Q12	0.748	16.01	Yes
F2-Q15	0.891	58.23	Yes

Table 6 — Assessment of AVE, CR and ICR

Factors	AVE	CR	ICR
Factor 1	0.542	0.920	0.878
Factor 2	0.742	0.904	0.882

be well above the recommended values. Lastly, the internal Consistency is evaluated using its Cronbach Alpha which has been already computed in the EFA section and assumed to be satisfactory when its value is more than 0.7 and considered to be very good if falls in the range of 0.8 to 0.9[22,23]. In Table 6, the ICRs are reported which are well above the recommended value of 0.7[20,22]. So, it is evident that the convergent validity is well satisfied to the individual recommended levels.

Discriminant validity

The degree to which the measures of different concepts are distinct is known as discriminant validity. It's a crucial step in figuring out how to analyze the links between latent variables[24]. Discriminant validity, in contrary to the convergent validity, determines whether the items do not mistakenly measure something else[25]. Cross-loading[20] and Fornell Larcker's[26] methods are the two techniques for discriminant validity measurements often used in PLS. Below the analyses are discussed in detail.

Cross loading approach

In the PLS-algorithm analysis, cross-loading is determined by associating each latent variable component score with all other items. When an indicator's loading for its related latent concept was larger than all the other constructs, discriminant validity was established. If any indicator's loading is higher for its designated construct compared to any other constructs, then it could be inferred that different constructs' indicators are not interchangeable. Table 7 delineates the results of cross loadings between constructs and indicators which depicts that all measurement items loaded higher against their respective intended latent variable compared to other variables.

Table 7 — Assessment of cross loadings for discriminant validity

		Factor 1	Factor 2
	Indicators	Indicator Loading	Cross Loading
Factor 1	Q1	0.7325	0.0919
	Q2	0.817	-0.065
	Q3	0.7638	0.0106
	Q4	0.7751	0.3667
	Q6	0.6891	0.1832
	Q9	0.6866	0.0904
	Q10	0.7287	0.2418
	Q16	0.6855	-0.0581
	Indicators	Cross Loading	Indicator Loading
Factor 2	Q7	0.1848	0.901
	Q8	0.1348	0.8964
	Q12	0.0873	0.7483
	Q15	0.0895	0.8914

Table 8 — Summary results of Fornell-Larcker Test for discriminant validity

	Factor 1	Factor 2
Factor 1	0.736	
Factor 2	0.146	0.861

Fornell-Larcker's approach

Fornell-Larcker method examines whether a construct shares more variance with its associated indicators than with any other construct. The analysis is valid if the square root of AVE for each of the factors is higher than the correlation between the factors. In Table 8, the diagonal elements indicating square root of the AVEs and the off-diagonal elements indicating between factor correlation. Evidently, the Fornell-Larcker's criterion is also satisfied.

Based on the above results, the reliability and validity of the measurement models were found to be satisfactory, so all the items in the measurement model are valid and fit to be used for estimating the parameters in the structural model.

Conclusion

To assist the users' and facilitate them with better service, it is essential to decode their tacit knowledge and convert it into explicit knowledge. Although this study has been done in Bolpur college library, the

methodology is generic and can be adopted in other libraries to improve the library services. This study is intended to provide a basic understanding and insight into TK to maximize the library usage. It ushers similar future TK research which may apply the above discussed factors and experimentally evaluate them against any variable, including organizational performance, service quality, and leadership, and so on.

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Annexure 1:

User survey of Bolpur college library

Factors involved in determining Tacit Knowledge of users of Bolpur college library

1. Library Orientation Programme was helpful to me
2. Library professionals are extremely helpful in locating required documents in Koha and to provide its Call Number
3. Library professionals also help in retrieving document from the shelves if I couldn't do it on my own
4. Librarians used to provide alternative References if a particular required document is unavailable
5. Librarians used to provide Referral Services as and when needed
6. Librarians used to cater personalised care to users with special needs
7. Library reading room is spacious, full of light, and airy
8. Library reading room is equipped with well-maintained study tables and chairs for students
9. Library professionals' cordiality and 'service with a smile' always increases user's desire for using the library more
10. Librarians' guidance helps me a lot in my study
11. Librarians' guidance helps me a lot in framing my future goal
12. Newspaper collection of the library help in searching jobs
13. Book Collection in this library is satisfactory
14. Number of copies available for a particular book present in syllabus is satisfactory
15. Journals available in the library is useful for my study
16. Library hours is flexible
17. The overall library environment is soothing and encouraging for heightening the level of knowledge