

Knowledge, Beliefs, and Practices Scale (KBPS) Development: Social Dimension Measures of Red Tide Phenomenon

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Abstract

The social dimension of red tide phenomenon is one of the fundamental pillars in coming up with holistic plans and programs for a resilient society. Exploring its underlying factors will provide valuable insights to the community for appropriate behaviors and decisions when faced with red tide related challenging situations. This study aimed to develop a tool that will assess the social dimension measures of red tide. It utilized exploratory sequential mixed methods research design. Literature reviews and in-depth interviews were used to gather qualitative data as a basis in the generation of items. An Exploratory Factor Analysis was employed to discover the underlying latent structure of the test. A 45-item scale with three-factor model was developed with the labels: Knowledge, Beliefs and Practices. Statistically, the Knowledge, Beliefs and Practices Scale showed excellent overall internal consistency ($\alpha = .93$) with strong coefficient alphas for Knowledge ($\alpha = .90$), Beliefs ($\alpha = .82$), and Practices ($\alpha = .73$) factors. A confirmatory factor analysis is carried using the PLS-SEM. The instrument exceeds the minimum requirement of the assessments for the convergent validity, discriminant validity, and reliability. The findings suggest that the proposed developed 45 items Knowledge, Beliefs and Practices Scale (KBPS) is valid and reliable for exploring the social dimension of red tide phenomenon. Thus, the use of the KBP Scale is highly recommended in generating information for social dimension of red tide, which then serve as inputs in strengthening the mitigation efforts for harmful algal blooms.

Keywords: Red Tide Phenomenon; Social Dimensions; Knowledge; Beliefs; Practices; Red Tide in Samar

1. Introduction

Red tide is a natural coastal phenomenon for the occurrence of harmful algal bloom (HAB) which adversely affects both health, economic livelihood of the people living in the communities, and destroy marine ecosystem. These HABs are caused by microscopic algae that produces toxins and can kill fish and make shellfish dangerous to eat. It occurs at different times throughout the year in Samar, one of poorest provinces in the Philippines. According to the Philippine Statistics Authority, through its website, as of December 2016, the poverty incidence of Samar is 39.5 percent which is the second highest in the Eastern Visayas region. With its condition, reoccurrences of red tide can have detrimental effects to the already challenging situation of the province especially Samareños living in the coastal communities.

The study of Morgan, Larkin, and Adams (2008) revealed that residents are dependent via newspaper and televisions on red tide updates and the use such media for information dissemination should be sustain and be used in correcting misunderstanding on red tide phenomenon so as to avoid or reduce revenue losses in local businesses. Meanwhile, there is widely inconsistency and incorrect response across tourists and residents alike regarding knowledge of Florida red tide (Hall et al., 2012). Additionally, Fleming et al., (2014) conducted a study on how people make decisions in situations of uncertain environmental health hazards like red tide.

A misconception pertains to incorrect view or opinion because it is based on faulty thinking or understanding. Davis (1997), classified misconception into preconceived notion, non-scientific or lacks scientific basis, conceptual misunderstanding, vernacular misconceptions, and factual misconceptions. Misconception about red tide phenomenon may affect people in two ways: first, practices of people which have no scientific basis are perceived by others as factual since it

was already their norms from the olden days and secondly the other way around. It was also revealed that local residents have deeper knowledge on Florida red tide than the tourist in that place. Though many outreach materials (print and web) and media exposure has been developed and utilized for information dissemination focusing on the problem but no formal assessment conducted on this material if it's really served its purpose of informing the public (Nierenberg et al., 2010). Moreover, Hall, et al., (2012) argued that people's misconception on red tide can affect their practices and beliefs of people and somehow decrease the chance of eliminating the problem.

There have been many studies on red tide especially on how the poisoning is happening inside the human body. With the health impact, human loss, and economic damages, there is a very limited literature which concerns into the social dimensions like scientific understanding, beliefs, and practices of Filipinos in mitigating red tide (Bankoff, 1999). Indeed there is no existing standard instrument to widen studies on red tide's social aspects. Communities that are affected by these phenomena must have accurate information. In order to address and explore more on the social dimensions of red tide, a standardized survey instrument is needed to measure the social dimensions of Samareños in mitigating red tide. It will help foster scientific understanding among Samareños which may alter their misconception and misbeliefs and likewise developed practices that can help in mitigating red tide. Furthermore, the aspirations and challenges of Samareños being affected by red tide are important information to policymakers to the interventions to be implemented in Samar province.

2. Objective

This study aimed to develop and validate a scale that will measure the social dimensions of Samareños in mitigating red tide.

3. Methodology

An exploratory sequential mixed method research design was used in the development and validation of Knowledge, Beliefs and Practices Scale (KBPS) that will measure the social dimensions of Samareños in mitigating red tide.

In an exploratory design, qualitative data was first collected and analysed, and themes were used to derive the development of a quantitative instrument to further explore the research problem. As a result of this design, three stages of analyses were conducted: primary qualitative phase, after the secondary quantitative phase, and at the integration phase that connects the two strands of data and extends the initial qualitative exploratory findings (Creswell and Plano Clark 2011). This design is especially useful when developing and testing an instrument that helps explore a phenomenon about which little is known or there is no instrument available. Therefore, this design is also known as the instrument development design (Creswell, Fetters, & Ivankova, 2004).

In this study, the first phase in the development of scale starts with item development using qualitative exploration of social dimensions of Red tide through in-depth interviews. Then the findings from this qualitative phase guided the development of Knowledge, Beliefs, Practices scale which will be evaluated in the third phase.

The step in the development of the scale was based on Boateng's, et.al. (2018) primer for best practices for scale development in measuring complex phenomena.

In gathering qualitative data, a phenomenological approach to qualitative exploration was undertaken because the purpose was to explore the social dimensions of red tide. Hence, in-depth interviews was conducted with a sample from the population to gain a thorough understanding of participants experiences on red tide. Participants were introduced to the study and were asked to read and sign the Informed Consent Form. After the interviews' permission was granted, all the interviews were audio-recorded and the interviewees were assured that their identity were kept confidential and that no associations between their identity and audio recording were made. During the interviews, a semi-structured interview guide was followed to make sure that all the interviewees were given the same information about the study and were asked the same questions.

Fifteen participants were interviewed and hence the data gathered were qualified for phenomenological data analysis using Collaizi's Framework.

The data from these interviews were thematically analysed, with the results informing the identification of items to be added or deleted from the initial questionnaire. After, expert judges evaluated each of the items to determine whether they represent the domain of Knowledge, beliefs and practices scale. Five experts examined the content of the items

generated.

For the Scale Development Phase, pre-testing of questions was administered to 100 Samareños using random sampling. After the pre-testing of questions, actual survey was administered to 600 Samareños. Guadagnoli and Velicer (1988) suggested that a minimum of 300–450 is required to observe an acceptable comparability of patterns, and that replication is required if the sample size is <300. Considering that two factor analyses were conducted in this study, exploratory and confirmatory factor analysis, 300 respondents was considered for each factor analysis. Respondents were randomly selected.

In scale development, item reduction analysis was conducted to ensure that only parsimonious, functional, and internally consistent items are ultimately included (Thurstone, 1947). Therefore, the goal of this phase was to identify items that are not or are the least related to the domain under study for deletion or modification.

In this study, factor analysis, both exploratory and confirmatory factor analysis, were used in reducing items. Factor analysis is a multivariate statistical procedure that has many uses. Firstly, factor analysis reduces a large number of variables into a smaller set of variables (also referred to as factors). Secondly, it establishes underlying dimensions between measured variables and latent constructs, thereby allowing the formation and refinement of theory. Thirdly, it provides construct validity evidence of self-reporting scales (Nunnally, 1978).

In this study, EFA was used to analyse the factor structure of the responses received on the interviews conducted and CFA was used to test the hypothesis that a relationship between the items included to measure the knowledge, beliefs and practices, and their underlying latent constructs exists.

4. Results and Discussion

The initial pool of items was developed from two sources. This included a thorough review of existing literature and qualitative data derived from in-depth interview with the respondents regarding their lived experiences on red tide.

In this qualitative phenomenological study using Collaizi's framework, the researchers discovered data about respondents experiences about red tide. Three themes emerged from the interviews as the social dimensions on understanding red tide. These dimensions are: (1) *Knowledge*, (2) *Beliefs*, and (3) *Practices*.

In this study, the qualitative phase provided an opportunity for item development. The researcher derived a total of 97 initial items for development of a scale to measure the level of Knowledge, beliefs and practices of Samareños about red tide. There were 20 items generated from literature and 77 items from interview.

The thorough review of related literature provides the basis for defining the domain, the use of in-depth interview moves the domain from an abstract point to the identification of its manifest forms. Hence, the statements to measure the Samareños understanding of red tide were expressive of their experiences and understanding of red tide considering that the main goal of this study is to develop a contextualized Knowledge, beliefs and practices scale.

After generating the initial item pool, content validity was conducted. The pool of 97 items was given to the experts. During the first validation process, the quantitative analyses showed that based on the result of the content validity index, there are seventeen (17) items that need to be omitted. Comments and suggestions from the experts were used as guide in revising items. The researcher consolidated all the result from the first validation and revised the items.

The researchers re-validated the instrument to the experts. After the expert validation is carried out twice, all items were valid using content validity index, also, no further comments/suggestions were given by the experts. After the content validation of the experts, from the initial pool of 97 items, the developed test has now 80 items. Pre-testing of revised instrument was conducted. The revised Knowledge, Beliefs, and Practices scale that was pre-tested was found to be highly reliable using Cronbach's alpha coefficient (80 items; $\alpha=.93$).

After the pre-testing of questions, actual survey for test development was administered to 600 respondents in Samar. Participants who were included in the in-depth interview and pilot testing were excluded in the actual administration of the instrument. After the conduct of the actual administration of the scale, item reduction analysis was done. In this study, exploratory factor analysis was used in reducing items.

In the first step of the exploratory factor analysis, the data was screened using the boxplot to identify outliers. Outliers are extreme values that would result in additional factor (Yuan, 2002) or reduced the number of factors (Bentler, 1999). Hence, outlier was deleted. The number of factors one extracts for an EFA is sensitive to outliers and can unduly influence the psychometric properties. There was 1 item that was deleted because it was considered as outliers. Out of 80

items, only 79 items were considered for the exploratory factor analysis.

The technique of Principal Axis Factoring with oblique rotation (promax) was used to examine whether the remaining items measured a single construct of the social dimension of red tide or whether multiple constructs underlay the set of items.

Furthermore, Pallant (2007) recommended measures that can be generated in SPSS to assess the factorability of the data: Bartlett's test of sphericity, which should be significant at $p < .05$, and the Kaiser-Meyer-Olkin measure of sampling adequacy, which should be 0.6 or above. For these items, Bartlett's test of sphericity was significant at $p < .000$, and the Kaiser-Meyer-Olkin measure of sampling adequacy value was 0.93. These items are therefore clearly factorable.

The principal axis factoring (PAF) extraction method has been shown to generate reliable solutions whether communalities are high or low (Kahn, 2006). Two techniques that are helpful in providing information to decide the number of factors are Kaiser's criterion (Kaiser, 1960), and Scree test (Cattell, 1966).

The Total Variance Explained provides the Initial Eigenvalues for the components with Eigenvalues greater than 1.0. There were fourteen components recorded eigenvalues above 1.0, and explain a total of 53.383 percent of the variance.

The scree plot (Figure 1.), suggests a four-factor solution. This is in contrast to the fifteen-factor solution offered by Kaiser's criterion, which has been criticized for the retaining too many factors in some circumstances (Pallant, 2007).

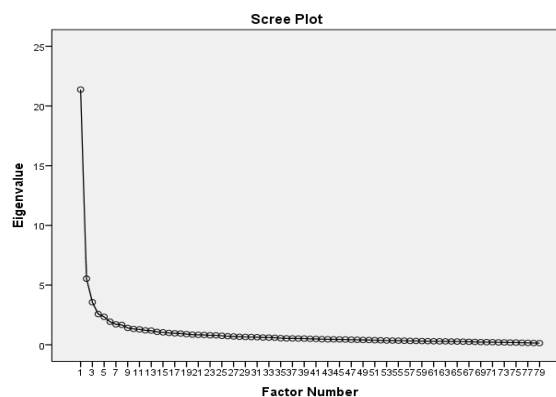


Fig. 1. Scree Plot of the Items in the initial EFA

While extraction helps the researcher determine the number of factors, rotation helps the researcher with interpreting the nature of those factors, by clustering the factors according to latent variables (DeVellis, 2012; Pallant, 2007). In this study, oblique rotation (Promax) was used since the underlying constructs are assumed to be correlated. Criteria for item deletion was determined by the values of the item loadings and cross-loadings on the factors, as well as communality estimates. Pett et al. (2003) specified that an item should be deleted if its factor loading is less than .40. Some have argued that an item communality below .40 is seen as potentially problematic; thus, it should not be retained (Costello, & Osborne, 2005).

In the first round of EFA, it revealed a fourteen-factor solution, however, Twenty-two (22) items were omitted because its factor loading is less than .40, crossloadings of items and there were items that did not load to any factor.

Accordingly, 58 items were retained in the initial EFA. Since, the criteria in the first EFA was not successfully met, second round of EFA was conducted. In the second round of EFA, 16 items were deleted due to crossloadings of items, items that did not load and items factor loading is less than .40, with this another EFA was run.

In the final round of the Exploratory Factor Analysis, Bartlett's test of sphericity was significant at $p < .000$, and the Kaiser-Meyer-Olkin measure of sampling adequacy value was 0.94. These items are clearly factorable.

The Total Variance Explained provides the initial eigenvalues for the components with eigenvalues greater than 1.0. These first three components recorded eigenvalues above 1.0, and explain a total of 57.484 percent of the variance.

The scree plot (Figure 2) suggests a five-factor solution which is in congruence to the three components offered by Kaiser's criterion using eigenvalues above 1.0.

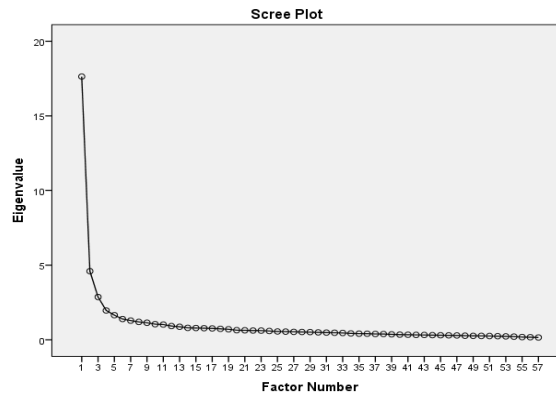


Fig. 2. Scree Plot of the Items in the final round EFA

The final round of EFA showed no communalities below .04. It also revealed a three-factor model. Items were loaded to factor 1, 2, and 3. Hence, it can be deduced that there were three factors resulted in the analysis.

The final scale of EFA was composed of 45 items. Factor 1 comprised of 19 items, 18 items for factor 2 and factor 3 is made up of 8 items. A total of 35 items were omitted from its 97 initial pool of items reducing the developed Knowledge, Beliefs and Practices Scale to 45 items.

The subscales are labeled as: Knowledge, Beliefs and Practices.

Table 1. Internal consistency coefficients of the subscales of the Knowledge, Beliefs and Practices Scale.

Subscale	Cronbach's alpha
Knowledge	.90
Beliefs	.82
Practices	.73
Overall alpha	.93

The 45 items retrieved from the Exploratory Factor Analysis section are re-examined with Confirmatory Factor Analysis. The dimensions include Knowledge, Beliefs and Practices.

Confirmatory Factor Analysis is conducted in conjunction with PLS-SEM analysis using the software called WarpPLS version 7.0. WarpPLS software provides the users with features of which are not available from other SEM software (Kock, 2015b). The software is the first to explicitly identify nonlinear functions connecting pairs of latent variables in SEM models and calculate multivariate coefficients of association accordingly. It is also the first software to provide classic PLS algorithms together with factor based PLS algorithms for SEM (Kock, 2014). Factor-based PLS algorithms generated estimates of both true composites and factors, fully accounting for measurement error. Original PLS design based its model estimation only on the composites; the linear combinations of indicators (Kock, 2014). Composite based do not take measurement error into consideration. With composite based the path coefficient tends to be weaker, thus leads to biased model parameter estimates particularly on the path coefficients and loadings (Kock, 2015a).

There are five main steps to be taken to analyse data with the software (Kock, 2010). Firstly, a project file is created. Then, the raw data is imported into the software. Data imported into WarpPLS automatically go through data pre-processing. The software checks and corrects missing values, zero variance problem, identical columns (also known as the indicators) names, and rank problems. The data are also standardised in step three. Standardised data columns have means that equal zero and standard deviations that equal one (Kock, 2010). As the pre-process are automatically carried out, it is crucial to correct missing values prior to importing the data into WarpPLS so that the percentage of corrected missing values do not exceed 25% as recommended by Sekaran & Bougie (2010). The data used in this research do not appear to have the respective above mentioned problem.

In this study, the measurement model was tested using confirmatory factor analysis to ensure that the model has sufficient validity and reliability.

Tests of validity and reliability were conducted on the measurement model. Validity can be defined as the degree to which a measure captures what it is supposed to measure. Also, it has been proposed that validity should be tested before establishing reliability (Hair, Anderson, & Tatham, 1998; Price, 1997). According to Hair et al. (1998), the strength of a measurement model can be demonstrated when testing for convergent and discriminant validity.

Convergent validity exists if different measures of the same concept are highly correlated, whereas discriminant validity exists if different concepts measured by the same method are lowly correlated (Price, 1997). In order to conclude

that a measurement model has acceptable convergent validity, the loadings of the indicators measuring the same construct should be equal to or greater than 0.5 (Hair, et al., 1998). Also, the loadings between constructs should not be too high, implying discriminant validity (Kline, 2005).

With respect to discriminant validity, it has been defined as the extent to which a construct is different from other constructs (Hair, et al., 1998). One way to test for discriminant validity is by analyzing the average variance extracted (AVEs). The AVE should be higher than any of the correlations involving the latent variable (Kline, 2005). In the table below the value is greater than any of the correlations below and to the left. Therefore it can be concluded that it pass the discriminant validity test.

Table 2. Correlation Matrix between the latent variables and square roots of AVE

	Knowledge	Beliefs	Practices
Knowledge	(0.867)	0.847	0.848
Beliefs	0.847	(0.752)	0.735
Practices	0.848	0.735	(7.605)

4.1 Reliability

Reliability can be defined as the extent to which a measure produces the same results when used several times (Hair, et al., 1998). One of the most common ways for measuring reliability is with Cronbach's Alpha. Its range goes from zero to one, with a higher value indicating a higher reliability. Acceptable values of Cronbach's Alpha are 0.7 or higher, and unacceptable values are below 0.5 (George & Mallery, 2003). Another way to measure reliability is through composite reliability (CR). CR considers that indicators have different loadings and it can be interpreted in the same way as the Cronbach's Alpha (Henseler, et al., 2009). Composite reliability coefficients are usually satisfactory above 0.7 (Nunnally & Bernstein, 1994). Table 3 presents the reliability coefficient. It can be deduced that the test is reliable both in terms of composite reliability and Cronbach's alpha reliability test.

Table 3. Variable reliability coefficient

	Knowledge	Beliefs	Practices
Composite reliability	0.921	0.864	0.803
Cronbach's Alpha	0.907	0.836	0.721

5. Conclusion and Recommendation

The developed and validated survey instrument allows exploration on some factors of social dimension of red tide phenomenon. The reliability and validity test result entails that the developed survey scale is a consequential tool for assessing person's level of Knowledge, Beliefs and Practices on red tide. Pertinent data can be generated by using this tool which could be beneficial in the formulation of plans and programs for red tide mitigation. This might as well rectify misconceptions of people's understanding on the phenomenon and eventually undertake appropriate actions and decisions in countering challenges relative to harmful algal blooms. Thus, the use of the KBPS on red tide is highly recommended for gathering reliable data as basis for an effective management system that can successfully mitigate recurring outbreaks of harmful algal blooms.

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