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Factor Analytic Approach for Constructing Affective Aspect of NPP Attitude Scale for Thai Undergraduate Students

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Abstract. This study aims at constructing an assessment of affective aspect of attitude towards nuclear power plant. By performing Exploratory Factor Analysis on 400 undergraduate students, 15 items with three factored structures were discovered which could explain the variance of this scale for 57.34%. Confirmatory factor analysis using the data of another 395 undergraduate students showed a good model. Reliability and validity of this scale were tested. Recommendations for further studies and implications were offered.

Keywords*:* affective aspect, attitude, nuclear power plant, undergraduate students, factor analysis

1. Introduction

At present, the world is facing crisis on global warming, as well as, energy scarcity which are tremendously affecting our everyday life and ultimately the future of mankind. Many countries are interested in new sources of energy especially nuclear energy.

Since the Fukushima Daiichi Nuclear Power Plant accident in March 2011 which was caused by a great earthquake of 9.0 richter followed by massive tsunami, citizens in Japan and around the world have increased their doubts and resistance on nuclear power plant (NPP) programs. However, the world needs more energy for its aging and more comfortable society, but has to balance for green society. Other alternative sources of energy (i.e., wind, solar, wave, and bio mass) cannot catch up with the demand of energy. NPP, technology proven of safety and producing a lot of reliable base load energy with less amount of raw material, is one of the upcoming, and may be an inevitable choices.

There are still resistant of using nuclear energy among citizens in many countries, especially in Thailand. Preparation of the citizens for NPP readiness is the urgent activity and long term battle. The first thing for psycho-behavioral scholars is to know the laypersons' beliefs, feelings, and readiness on NPP in order to establish interventions in terms of curriculums, programs, and activities for changing their attitudes and reduce the resistance. Therefore, psychological measurement on affective aspect of NPP attitude in Thailand is needed.

This study aimed at constructing psychological measurement on affective aspect of NPP attitude by using factor analysis for Thai undergraduate students who will be our new generation in nuclear era.

2. Affective Aspect of NPP Attitude

Feelings about something have strong effect on readiness and ultimately behavior towards that thing. Feelings or emotions are a part of attitude as Figure 1 [1] which represents general emotional perceptions of a targeted object, such as positive/negative, good/bad, or favorable/unfavorable evaluations

Individuals are usually afraid of new innovations which they are not familiar with. For example, in the past about 100 years ago, Thai people had bad impressions on camera. They believed that the camera could

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capture their soul. But at present, almost everyone has portable camera.

History may repeat itself on nuclear technology. Even though this technology has been advanced as many scholars guarantee for its safety. However, laypersons have not been familiar with nuclear. In addition,

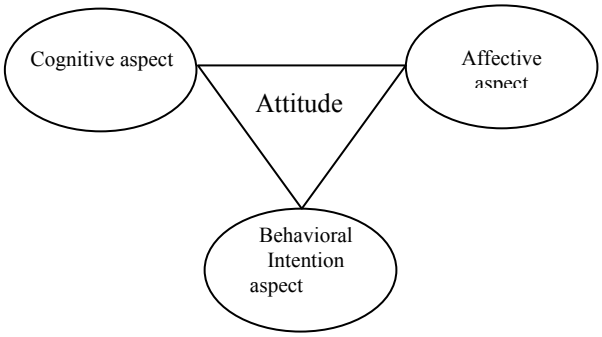

Fig. 1: Aspects of Attitude

they have misconceptions of nuclear energy from movies and media which cause nuclear energy worst reputation [2].

Many scholar and researchers have been interested in investigating attitude toward new technology especially computer [3][4] . Even though, some researchers have studied nuclear attitudes [6][7][8], but there is still little studies on constructing affective aspect of NPP attitude scale, especially in Thailand.

In foreign studies, nuclear attitude was assessed by asking about the degree that the participant will support or oppose NPP [9]. Nuclear attitude is also studied in terms of nuclear fear and anxiety [9][10]. A study on nuclear anxiety [11] [12] used the nuclear attitude questionnaires, consisted of 15 items, assessed beliefs, emotions, and reactions toward nuclear war, nuclear weapons, and nuclear power plant. Of these 15 items, only 4 items were assessed about nuclear power which only 2 of the 4 items were assessed of feelings about NPP in terms of feel frightened, and feeling of agreement to support NPP in other countries.

Therefore, affective aspect of NPP attitude is defined as an individual's emotional perceptions of nuclear power plant in terms of favorable/unfavorable, like/dislike, fear, afraid of, and anxiety. This measure is in the form of summated rating scales with 6 point Likert typed scale.

3. Research Methodology

3.1. Samples

Total sample of 817 junior and senior undergraduate students from two universities were obtained. Of these numbers only 795 completed data were used in this study. The samples were divided into two groups. The first group of 400 undergraduate students was employed for exploratory factor analysis (EFA). Of these number, there were 301 females (75.3%) and 98 males (24.5%). They also divided into two majors: social science majors with 219 students (54.8%) and science major with 181students (45.3%). The average age was 21years old (SD = 0.73), and GPA of 2.69 (SD = 0.45).

The second group of 395 similar undergraduate students was employed for confirmatory factor analysis (CFA). Of these number, there were 276 females (69.9%) and 115 males (29.1%). They also divided into two majors: social science majors with 270 students (68.4%) and science major with 125 students (31.6%). The average age was 21years old (SD = 0.85) , and GPA of 2.62 (SD = 0.46).

3.2. Measure

The affective aspect of NPP attitude scale employed a multilevel constructing process. In the preliminary stage, the researcher reviewed re literature relating to attitude toward technology, and technology phobia. Based on the review, the researchers constructed 40 items. Experts on nuclear energy and psycho-behavioral science suggested to select the suitable 20 items for undergraduate students.

Undergraduate students were asked to rate their response on the 20 items relevant to feelings toward NPP. This measure accesses the degree of emotions, feelings, anxiety about NPP (e.g., afraid of NPP, be

worried about waste from NPP). The scale was in the form of summated ratings scale with 6 point Likert-type scale ranging from "totally agree" (6) to "totally disagree" (1).

NPP site acceptance. This measure accesses the undergraduate student's degree of agreement to the construction NPP on 5 possible sites, i.e., anywhere in Thailand (TH), some place in the same province that the university is located (EP), some place in home province (HP), some place in home district (HD), and someplace in home village (HV). The participants were asked to give a score ranging from "0" (not at all) to "100" (totally) to indicate their agreement.

3.3. Data Collecting and Analysis

All 20 items were administered to the undergraduate students. Two statistical approaches: t-ratio for determining item discrimination (with the criteria of $t \geq 2.00$), and item-total correlation for determining unidimensionality (with the criteria of $r \geq 0.20$) of each component were used as the first screening step. The selected items were used in the step of exploratory factor analysis (EFA). The reliability of the scale was computed after EFA. The next stage was to confirm the construct dimensions from EFA by performing CFA. Predictive validity in terms of correlations between this scale and NPP site acceptance was done.

4. Results

4.1 Item Analysis

The affective aspect of NPP attitude scale was primarily chosen to be tested with the total of 20 items. By computing t-ratio (for item discrimination), and item-total correlation (Table 1), 19 of 20 items passed the criteria with t-ration ranged between 4.23 to 15.26, and item-total correlation ranged between 0.26 to 0.68.

Table 1 t-ratio (t-value) and item-total correlation (r)

Item No.	t-value	R	Item No.	t-value	Item No.
1	10.70*	0.58*	11	11.68*	0.68*
2	12.46*	0.69*	12	2.48*	0.20*
3	5.85*	0.38*	13	5.40*	0.37*
4	13.06*	0.68*	14	4.55*	0.27*
5	9.44*	0.55*	15	3.12*	0.14
6	6.54*	0.45*	16	5.34*	0.41*
7	8.37*	0.48*	17	3.90*	0.35*
8	11.32*	0.58*	18	8.02*	0.55*
9	8.55*	0.42*	19	8.95*	0.58*
10	15.45*	0.75*	20	6.94*	0.47*

* $p<.05$

4.2 Exploratory Factor Analysis

The selected 19 items were tested by EFA using principal components factor analysis. Result of EFA from another 400 undergraduate students showed KMO and Bartlett's test = 0.88, chi-square = 2191.12, df = 105, significant level = .00. Table 2 shows that only 15 of 19 items were grouped into 3 factors, each yield eigenvalue more than 1.00 with the total cumulative percentage of 57.34.

According to Table 2, the first factor is consisted of 6 items, all in positive direction. These items reflect the feelings of "not afraid of" which were based on many scientific evident reasons, e.g., not produce pollution, trust in waste management technology. The eigenvalue of this factor is 5.29. All 6 items can explain this construct for 35.24%

The second factor, consisted of 5 negative items, is related to the feeling of "afraid of NPP" connecting to perception of bomb, war, and disease. The eigenvalue of this factor is 5.29. The eigenvalue of this factor is 1.97. All 5 items can additionally explain this construct for 13.13%. When combined with the items from the first factor, all 11 items yield the total explanation of 48.37%

The last set of 4 negative items represents the third factor that reflects the feeling of "dislike NPP" due to misperception, e.g., refusing of new technology, and misunderstanding that NPP will object the Philosophy

of Sufficiency Economy. The eigenvalue of this factor is 1.35 All 4 items can additionally explain this construct for 8.97%. When combined with the items from the first two factors, all 15 items yield the total explanation of 57.34%

Table 2 Factor Loading and Cumulative Percentage of Affective Aspect of NPP Attitude

No.	Item	Factor loading		
		1	2	3
1	Aff 16: I would like to have NPP because it does not pollute like coal (+)	0.73		
2	Aff 4: I would like to have NPP in Thailand (+)	0.73		
3	Aff 18: I am proud to be a part of supporters of NPP in Thailand (+)	0.71		
4	Aff 13: I think NPP protesters are not far-sighted persons (+)	0.69		
5	Aff 17: I have learned that new technology can handle high level waste well (+)	0.73		
6	Aff 3: Even though, there were nuclear bombs, but Japan has many NPPs.Thus, I am not afraid of NPP. (+)	0.54		
7	Aff 19: If there is NPP in Thailand, I am afraid of serious related diseases, e.g., leukemia. (-)		0.80	
8	Aff 9: When I think about NPP, it leads me to think of cancer. (-)		0.78	
9	Aff 7: I am worried about management of radiating nuclear wastes (-)		0.75	
10	Aff 11: I am afraid that NPP could be blasted like what happened in foreign countries. (-)		0.69	
11	Aff 8: When I think about NPP, it leads me to think of nuclear war. (-)		0.59	
12	Aff 14: Who support NPP are the ones that do not follow Philosophy of Sufficient Economy. (-)			0.77
13	Aff 6: NPP is a new innovation for me. So I refuse it first. (-)			0.71
14	Aff 10: I does not like NPP. (-)			0.54
15	Aff 1: I have bad feelings about NPP. (-)			0.53
	Eigenvalue	5.29	1.97	1.35
	% of variance	35.24	13.13	8.97
	Cumulative %	35.24	48.37	**57.34**

4.3 Confirmatory Factor Analysis

Confirmatory factor analysis was carried out in the second stage to confirm the three structural dimension of this scale. Data from new group of 395 undergraduate students were used. The indicators confirmed model are goodness of fit statistics ($\chi 2$ = 126.26, p-value, 0.000448, df = 78, RMSEA = 0.0381, NFI = 0.976, CFI = 0.991, SRMR = 0.045, GFI = 0.960, AGFI = 0.939). The proportion of chi-square to degree of freedom is less than 2.00 for the three factored structure. The NFI, CFI, GFI, and AGFI should equal to or higher than 0.90. RMSEA and SRMR values should less than 0.06. Thus this model is accepted as a good model.

4.4 Reliability and Validity

The final stage was to examine the scale's ability to predict thoughts or support of NPP construction in Thailand. Table 3 displays correlation matrix among affective aspect of NPP attitude and the 5 NPP site

Table 3 Correlation Matrix Among Affective Aspect of NPP Attitude scale and 5 NPP Site Acceptance Scores (N = 395)

	AFT	TH	EP	HP	HD
AFT	-				
TH	.580**				
EP	.528**	.584**			
HP	.501**	.570**	.908**		
HD	.500**	.512**	.844**	.932**	

HV	.447**	.447**	.709**	.800**	.838**

** Correlation is significant at the 0.01 level,* at the .05 level.

acceptance scores. It was found that all correlation coefficients between the affective aspect of NPP attitude

and the site acceptances were moderate and in positive direction. It can be said that students who were more favorable feelings towards NPP are the ones who agree with the construction of NPP in any place in Thailand (r = 0.580) including their backyard (r = 0.447). The reliability of the 15 items is 0.8721.

The scores of this scale ranged from 15 to 90. The average score of Thai graduate students is 44.54, with median score of 45.00 and SD equals to 11.13.

5. Conclusion and Discussion

This study aims at constructing a measure that can access feelings on nuclear power plant in Thai undergraduate students using factor analysis approach. This scale is one of the early well qualified attitude measures on NPP in Thailand.

The affective aspect of NPP attitude scale consisted of 15 items with three factored structures, with rather high reliability, and moderate predictive validity. This scale can be used to in future studies on perceptions and feeling about NPP which now is the urgent issue for nuclear public acceptance. Thus, the scale will be useful to differentiate persons who favourable or unfavourable of NPP in order to plan and implement a direct and effective interventions that suitable for each specific groups.

Further research on constructing other attitude scales relating to NPP needs to be conducted. This scale can be the foundation for constructing attitude towards NPP scales in other significant Thai groups, e.g., local authorities, key village persons, teachers, public health workers.

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