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Articles

Thai Students' Attitudes and Concepts of Technology

Kurt H. Becker and Somchai Maunsaiyat

Introduction

Of the eight major programs mentioned in Thailand's Eighth National Education Development Plan (1997-2001), one is aimed at developing human capability in the areas of science and technology. This is to address the fact that the teaching of technology in Thailand is lagging behind the technological changes of the last decade. Part of this reform effort is the development of conceptual based learning activities in science and technology for 12 to 15-year old students. These concepts are being introduced through the offering of a subject at the high school level. de Klerk Wolters (1989) indicated learning the concepts of technology is necessary and should be required for all students of this age range. Cross and McCormick (1986) added that students in both primary and secondary schools need to learn to solve technological problems in creative ways. Students also should understand the nature of technology. Understanding technology is just as important for Thai students as it is for students in other countries.

In order to develop a student's technological literacy, de Klerk Wolters (1989) suggested that it is important to take into account pupils' interests, opinions, and needs when developing technological curriculum. An understanding of students' knowledge of and attitudes toward technology is necessary and prerequisite to effective teaching about technology (Bame, Dugger, de Vries, & McBee, 1993). These concerns led to the development of the Pupils' Attitude Towards Technology (PATT) project. The first Pupils' Attitude Towards Technology project was established by Jan Raat and Marc de Vries in 1984 at the University of Technology in Eindhoven in the Netherlands. The main purpose was to assess what attitudes students, aged 11 to15, had toward technology.

It became evident through the PATT research that the students had incomplete and vague concepts of technology. There also appeared to be great differences between boys and girls in their attitudes toward technology. Since this beginning, the PATT research has been conducted in over 22 countries,

Kurt H. Becker (kbecker@cc.usu.edu) is an Associate Professor and Somchai Maunsaiyat is a doctoral student in the Department of Industrial Technology and Education, College of Engineering at Utah State University, Logan, Utah.

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including the PATT-USA study conducted by Bame and Dugger in 1990. In 1993, a shortened version of the PATT-USA instrument was developed by Jeffrey. This Technology Attitude Scale (TAS-USA) instrument was intended for use by American teachers at the middle school level to determine the students' attitudes toward technology.

Based upon the literature, the researchers in this study believed that an assessment of the attitudes and understanding of technology among students was necessary before technology curriculum reform in Thailand could begin. Teachers, administrators, parents, curriculum developers, and students would all benefit from such an assessment. Thus, there was a clear rationale for conducting a PATT study in Thailand.

Purpose of Study

The purpose of this study was to develop a Technology Attitude and Concept Scale (TACS-Thai) instrument by translating and validating the revised TAS-USA instrument. The instrument developed in this study was used by Thai teachers at the secondary school level to determine the attitudes and concepts of technology among 12 to 15 year-old students in the Bangkok metropolitan area. The specific objectives of this study were:

1. To develop the TACS-Thai instrument by adaptation of the TAS-USA and the PATT-USA instrument.
2. To develop a Thai version of the Technology Attitude and Concept Scale (TACS) by translating the US version.
3. To validate the TACS-Thai instrument for use by Thai teachers at the secondary school level. This included the determination of appropriate language and word usage within the instrument through the use of a pilot study.
4. To analyze each section of the TACS-Thai through a panel of experts and statistical analysis.
5. To provide comparisons between PATT-USA and TACS-Thai studies.
6. To provide the recommendations for the improvement of developing the TACS-Thai instrument.

Methodology

The Technology Attitude and Concept Scale (TACS-Thai), an adaptation of the Technology Attitude Scale (TAS-USA) and the Pupils' Attitudes Towards Technology (PATT-USA), was used to collect data in the study. The adaptation of both original instruments maintained consistency with the original design in that the purpose was descriptive, "...the instrument is not a test instrument but a descriptive instrument" (Ratt, 1992, p.31).

The general procedure followed to validate the TACS-Thai instrument consisted of the following:

1. Present the translation of the instrument to a panel of experts to examine for appropriate language, clarity and brevity.
2. Modify statements on the instrument according to the suggestions from the panel of experts.

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3. Conduct a pilot study to determine if the directions, statements, time to complete the instrument, and analysis of data were conducive to continuing the validation process.
4. Complete analysis of the data for reliability using Cronbach's alpha coefficient for homogeneity on the attitude scale and the Kuder-Richardson formula 20 (KR-20) on the concept scale.
5. Interpret the analysis of data as it pertained to validation of the instrument.

Instrument

In the mid-1980s researchers in the Netherlands initiated a large-scale study to determine what pupils' attitudes and concepts were regarding technology. The Pupils' Attitudes Towards Technology (PATT) instrument was a result of this research effort that soon spread to several other countries. Bame, Dugger, de Vries, and McBee (1993) conducted a large-scale research study on attitudes towards technology in the United States, resulting in the PATT-USA, that reported over 10,000 responses from students between the age of 13 and 15 who were enrolled in technology education/industrial arts classes from seven states. The instrument incorporated a Likert scale for measurement and consisted of 100 items.

In 1987, the Technology Attitude Scale (TAS) instrument was developed from the large-scale PATT-USA research. The three-part TAS instrument was designed specifically for use by classroom teachers to determine students' attitudes towards technology and concepts of technology. In 1993 the TAS instrument was adapted and validated by Jeffrey for use by American teachers at the middle school.

The first section of the TAS was designed to obtain demographic information about the respondents. The second section, the attitude scale, was designed to obtain information about students' attitudes towards technology through the use of 26 expressions, or items, divided over six subscales. Respondents completed the attitude scale by specifying to what extent they agreed with each statement by using a five choice Likert scale: strongly agree, agree, neutral, disagree, and strongly disagree.

The third section of the instrument, the concept scale, was designed to obtain information about the students' concepts of technology, utilizing 28 items divided over four subscales. The conceptual section measured the cognitive or knowledge aspects, based on five generally accepted characteristics (de Vries, 1987) of the concepts of technology. The concept scale measured the knowledge and concepts of technology at a relatively abstract level. Students responded to the concept scale by indicating Agree, Disagree, and Don't Know.

The TAS-Thai instrument was adopted from the TAS-USA instrument. It consists of 63 items or statements that cover both attitude and concept scales. There are 26 items divided over six subscales in the attitude scale. The subscales of the attitude scale include: *interest* (five statements), *role pattern* (four statements), *consequences* (five statements), *difficulty* (three statements), *curriculum* (four statements), and *career* (five statements). There are 28 items

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divided over four subscales in the concept scale. The subscales of concept scale include: *technology and society* (10 statements), *technology and science* (six statements), *technology and skills* (seven statements), and *technology and pillars* (five statements).

The first section of the instrument (nine items) was designed to obtain demographic information about the respondents. This included gender, age, grade level, involvement with technology education (present or previous enrollment in a technology education class), parents' occupations, and the nature of the technological environment at home. These questions were not included in the original TAS-USA. The newly designed instrument was then translated into the Thai language and was validated and tested for reliability.

Instrument Validity and Reliability

The TAS-USA instrument developed by Jeffrey (1993) was determined to be valid and reliable. The content validity was established though the utilization of a panel of experts. The reliability correlation values for the attitude scale were obtained through the statistical application of Cronbach's homogeneity coefficient alpha. An alpha-value of at least .60 was set for the acceptance of the TAS. The reliability estimates for the concept scale were obtained through the statistical application of the Kuder-Richardson formula 20 (K-R 20) to obtain internal consistency values.

In the large group study in the US (n = 183) an overall alpha coefficient of .81 was found on the attitude scale and an overall reliability coefficient of .83 for the concept scale (Jeffrey, 1993). Therefore, the content validity and reliability of the TAS-USA instrument were considered to be acceptable for use in measuring students' attitudes and concepts of technology.

In developing the TACS-Thai instrument from TAS-USA, five additional items about demographics of students were added. A panel of experts was used to establish content validity for the TACS-Thai instrument. Members of the panel were selected because of their experience in translating the English language into the Thai language, expertise in instrument development, and expertise in the use of statistics. An English teacher from the Department of Social Studies and Language, King Mongkut's Institute of Technology Ladkrabang (KMITL), was selected to be a member of the panel. Two individuals from the Supervisory Unit in the Department of General Education with knowledge and experience related to secondary school students and secondary school curriculum were also selected to serve on the panel of experts. In addition, the instrument was reviewed by a professional statistician from the Office of Graduate Studies, KMITL, and a professor from the Department of Measurement and Evaluation, Faculty of Education, Srinakharinwirot University, to insure that the format of the instrument and data were acceptable for statistical analysis. The panel examined all translated statements for appropriate language and word usage and made suggestions about item terminology to enhance clarity and conciseness. This procedure was consistent with Ary, Jacobs, and Razavieh (1985) regarding content validity: "In order to

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obtain an external evaluation of content validity, the test maker should ask a number of experts or other teachers to examine the test content systematically and evaluate its relevancy to the specified universe" (p. 215).

Ary, et al. (1985) also described reliability as the "degree of consistency with which an instrument measured what it is supposed to measure." The Cronbach alpha procedure was used to obtain the reliability estimate of the internal consistency of the attitude measurement section of the TACS-Thai. McDaniel (1994) suggested that "the Coefficient Alpha is a suitable procedure to use when responses get a specific value as in an attitude scale where responses range from strongly agree to strongly disagree" (p. 64). Mueller (1986) also mentioned that "tests with items scored along a continuum, such as Likert scale attitude items (scored 1 through 5), require the use of Alpha" (p. 61).

van den Bergh (1987) stated that, "an Alpha-value at least more than .60 indicates a good reliability of scale " (p. 43). Therefore, an alpha-value of at least .60 or higher was the target number set as a goal for the acceptance of the TACS-Thai.

The Kuder-Richardson Formula 20 (KR-20) procedure was used to obtain the reliability estimate of the internal consistency of the concept measurement section of the TACS-Thai instrument. The Kuder-Richardson Formula 20 is "probably the best known index of homogeneity . . . and is based on the proportion of correct and incorrect responses to each of the items on a test" (Ary, et al., 1985, p. 233). McDaniel (1994) mentioned that Kuder-Richardson is a form of coefficient alpha that is applicable when items are scored as "right" or "wrong" (p. 52). The concept measurement section of the TACS-Thai was scored using a dichotomous procedure (Correct = 1; Not Correct or Don't Know = 0).

The TACS-Thai Pilot Study

In an effort to test the appropriateness of the language and word usage in the TAC-Thai instrument, along with a determination of its validity and reliability, a pilot study was conducted. The students selected for the pilot study were not included in the main study. The pilot study sample consisted of 80 secondary school students at Panyaworakun School, Nongkham, Bangkok. There were 34 boys (42.5 percent) and 46 girls. Their age ranged from 13 to 15 years. Most of them were age 14 (72.5 percent). All of them were in the eighth grade. Thirty two students (40 percent) had taken a course in technology education. Eighty percent of the pilot study sample had technical toys at home. Only 24 (30 percent) of 80 students had a technical workshop at home. Eighteen students (22.5 percent) had a computer at home.

In addition to completing the instrument, the students were asked to circle any words they did not understand and to indicate any difficulties they had in completing the instrument. Modifications to the instrument were made with consideration given to the original intent of the instrument with the guidance of the panel of experts.

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The alpha coefficient values for the attitude scale of the pilot study are summarized in Table 1. As shown in Table 1, the alpha coefficient of two subscales (subscale 2, ∝ = .66 and subscale 6, ∝ = .62) exceeded the minimum .60 alpha value criterion. The alpha of subscale 5 (∝ = .57) was very close to the minimum criterion. The other three subscales (subscale 1, ∝ = .32; subscale 3, ∝ = .32; and subscale 4, ∝ = .14) did not meet the criterion. However, the overall correlation alpha for all subscales (∝ = .74) exceeded the minimum .60 value.

Table 1
Alpha Values of Attitude Scales in Pilot Study

Subscales		∝
1	Interest	.3217
2	Role Pattern	.6609
3	Consequences	.3164
4	Difficulty	.1440
5	Curriculum	.5746
6	Career	.6227
	Overall	.7380

Table 2 shows the values of the alpha coefficient for the concept scale of the pilot study. Two of the four subscales (subscale 1, ∝ = .51 and subscale 2, ∝ = .51) were close to the minimum .60 value indication. The alpha of subscale 3 (∝ = .38) and subscale 4 (∝ = .36) did not meet the minimum value. However, the overall alpha of all subscales (∝ = .72) did meet the criterion value. In consultation with a professional statistician, the researcher made the decision to proceed with the administration of the TACS-Thai instrument to the primary sample.

Table 2
Alpha Values of Concept Scales in Pilot Study

	Subscales	∝
1	Technology and Society	.5073
2	Technology and Science	.5087
3	Technology and Skills	.3827
4	Technology and Pillars	.3642
	Overall	.7219

Subjects

The accessible population for this study consisted of the lower secondary school students from one private school and three public schools in the Bangkok metropolitan area. These schools operate under the Department of General Education. The selected schools were recognized as leaders in providing technology education because they had a technological environment and

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students were engaged in technology-related activities such as the School-Net project, which provided more opportunities to use modern technology.

The sample in this study consisted of 616 students enrolled in the four secondary schools mentioned above. Specifically, the schools were Saint Mary College (private rural, n = 177), Protpittayapayat School (public rural, n = 147), Panyaworakun School (public rural, n = 150), and Prakhanong Wittayalai School (public urban, n = 142). This sample was considered to be representative of the whole population of the four selected schools with respect to sex, gender, grade, geographical variations, and school types. A sample size of at least 400 students was selected according to the suggestion of Krejcie and Morgan (1970, p. 211), who stated that "with the given population sizes of 100,000, a sample size of 384 is required." In addition, Gay (1996) suggested that "beyond a certain point (about 5,000), the population size is almost irrelevant and a sample size of at least 400 will be adequate" (p. 125).

According to Ary, et al. (1985), stratified sampling can be used when the population contains a number of subgroups or strata that may vary in the characteristic being studied (p. 142). Stratified sampling, according to Ary et al. (1985), ensures that each class of the population was adequately represented in the sample. Because this study included secondary school students in the seventh, eighth, and ninth grades from selected schools in the Bangkok metropolitan area, a stratified sampling was used.

Data Collection

The TACS-Thai instrument was delivered by the researcher to the coordinating teachers with instructions. The instrument was then administered to the sample students in random classes in the seventh, eighth, and ninth grades of each selected school. Individual instruments were hand scored and analyzed through the Office of Graduate Studies, Faculty of Industrial Education, KMITL.

Data Analysis

The instrument was analyzed by means of the statistical analysis package SPSS/PC+. Principal analysis procedures included the calculation of descriptive and frequency statistics of the data. Cronbach's homogeneity coefficient alpha was employed to determine the reliability and internal consistency of the attitude measurement section of the instrument. The Kuder-Richardson Formula 20 was used to determine the reliability and internal consistency of the concept measurement section of the instrument. Consultation was sought from a statistician familiar with the software and social research while preparing the data for processing and analysis.

Results

Findings of the Large Group Administration

The main administration of the TACS-Thai involved 292 boys and 324 girls at the four selected secondary schools in Bangkok, Thailand. The ages of the

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students ranged from 11 to 16 years in seventh, eighth, and ninth grades. Of 616 students completing the TACS-Thai instrument, 73.4 percent (452) had completed a technology education class.

Technological Climate in the Home

Five questions were asked to assess the technological climate in the home. These dealt with the student's perception of the technical nature of their parents' jobs and the presence of technical toys in their home. These findings are detailed in Table 3.

Table 3
Technological Climate in the Home

Category	*n*	%
Extent father's job has to do with technology		
Very Much	21	3.4
Much	129	20.9
Little	164	26.9
Nothing	280	45.5
Extent mother's job has to do with technology		
Very Much	14	2.3
Much	75	12.2
Little	146	23.7
Nothing	363	58.9
Technical toys in the home		
Yes	543	88.1
No	73	11.9
Technical workshop in the home		
Yes	202	32.8
No	407	66.2
Personal computer in the home		
Yes	108	17.5
No	507	82.3

About one fourth of the students (24.3%) believed that their father's job had "much" or "very much" to do with technology. Only 14.5 percent of students believed their mother's job had very much or much to do with technology. Over one half of the student's (58.9%) believed that their mother's job had nothing to do with technology. A large majority (88.1%) of the students indicated that technical toys were present in their home. Only 32.8 percent indicated the presence of a technical workshop in the home. Slightly less than a fifth (17.5%) indicated there was a computer at home.

Cross Comparison of Demographics

Gender differences were explored relative to the demographics section

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of the instrument. A summary of the findings are shown in Table 4 and may be summarized with the following statements:

1. *Gender and Age*: The girls tended to be younger than the boys. That is, there were proportionally more girls who were 13 or younger than there were boys, and there were proportionally more boys than girls who were 15 or older.
2. *Gender and Grade Level*: Almost one third of the boys and girls were in each grade level.
3. *Gender and Home Environment*: Girls tended to rate the father's job as less technical in nature than did the boys. That is, 73 percent of the girls, compared to 70 percent of the boys, rated their fathers' job and having "Little" or "Nothing" to do with technology. Girls tended to rate the mother's job as less technical in nature than did the boys. That is, 84 percent of the girls, compared to 81 percent of the boys, rated their mothers' job and having "Little" or "Nothing" to do with technology. The existence of technological objects, such as toys, workshops, and computers was viewed as an indicator of how technological the home environment was. For all such indicators, a greater proportion of boys than girls perceived their home as technological.

Three attitude subscales (*general interest in technology, gender difference, and consequences of technology*) were selected to compare to the results in the US study. To determine if the demographic characteristics had any effect on attitudes toward technology, analyses of variance (ANOVAs) was used (see Table 5 and 6).

The relationship of demographic characteristics to attitudes toward technology can be summarized as follows:

1. The gender of the students had a significant effect on all attitude subscales. The reader is reminded that a lower scale value represents a more positive attitude. Boys (mean = 2.32) indicated a greater interest in technology than girls (mean = 2.45), and girls (mean = 1.98) rated technology as having a more positive consequence than did the boys (mean = 2.05). In addition, there was a significant difference between boys and girls on their attitude toward gender differences regarding technology. Girls appeared to view technology as an activity for both genders more than boys did. No significant effect of grade level on general interest in technology or the consequences of technology was found. However, the gender differences of the ninth grade level students were significantly greater than those of students in the lower grade level.
2. The extent to which a student's father was reported as having a job dealing with technology was significantly related to only one of the three subscales, Gender Differences. The differences attributed to the technological nature of
   a father's job on the attitude scale and Technology is an Activity for Both Girls and Boys, were not linear. Those students reporting "Little" (mean = 2.56) or "Much" (mean = 2.50) viewed technology as an activity for both

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sexes significantly more than students who reported "Very Much" (mean = 2.86).

Table 4
Cross Comparisons of Gender with Student Characteristics and Home Environment.

	Boys		Girls	
	n	%	*n*	%
Age of students				
12 or younger	58	19.86	96	29.63
13	107	36.64	109	33.64
14	98	33.56	101	31.17
15	26	8.90	17	5.25
16 or older	3	1.04	1	0.31
Grade in school				
7th	97	33.22	116	35.80
8th	100	34.25	100	30.86
9th	95	32.53	108	33.34
Extent father's job has to do with technology				
Very Much	16	5.48	5	1.54
Much	61	20.89	68	20.98
Little	71	24.32	93	28.70
Nothing	135	46.23	145	44.75
Extent mother's job has to do with technology				
Very Much	11	3.77	3	0.93
Much	32	20.89	43	13.27
Little	74	25.34	72	22.22
Nothing	163	55.82	200	61.73
Do you have technical toys at home?				
Yes	268	91.78	275	84.87
No	24	8.22	49	15.13
Is there a technical workshop in your home?				
Yes	111	38.01	91	28.09
No	239	81.85	268	82.72

3. The number of students' mothers who had jobs dealing with technology was significantly related to only one of the three subscales, Gender Differences. Results pertaining to the subscale, Technology is an Activity for both Girls and Boys were not evident. The significant difference was between those reporting "Much" or "Little" and those reporting "Very Much." The former group viewed technology as something for everyone, regardless of sex, to a significantly greater extent than did the latter group.
4. Having technical toys at home, having a technical workshop at home, or having a personal computer at home did not seem to make a difference in students' attitudes toward technology.

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5. Taking or having taken industrial arts or technology education courses made a significant difference on all attitude subscales except the Technology is Difficult scale. Such course experiences also made a difference on the Technology and Society concept scale. Students who had taken technology classes displayed greater knowledge about technology than did students who had no exposure to the classes.

Table 5
Results of One-Way ANOVAs on Grade, Father's Job and Mother's Job

Characteristics	General Interest in Technology	Gender Differences	Consequences of Technology
7th	2.33	2.63	2.06
8th	2.44	2.73	2.00
9th	2.40	2.56	1.98
Significance		*	
Extent father's job has to do with technology			
Very much	2.25	2.86	1.93
Much	2.33	2.50	1.95
Little	2.41	2.56	2.06
Nothing	2.43	2.72	2.01
Significance		*	
Extent mother's job has to do with technology			
Very much	2.30	2.98	1.91
Much	2.26	2.43	1.87
Little	2.40	2.53	2.06
Nothing	2.43	2.70	2.02
Significance		*	

* alpha significance <= .01

Comparisons Between the Results from the PATT-USA and TACS-Thai Studies

Overall, Thai students had lower mean scores in the general interest in technology subscale, implying that they had a higher general, overall interest in technology. This greater interest was maintained as well when the Thai students were sub-grouped according to the variables of the study.

Overall, US students had lower mean scores in the gender difference subscale, implying that they regarded technology as an activity for both sexes more than did their Thai counterparts. The means of the subscale on the consequences of technology were nearly the same for both US and Thai students, implying similar opinions on the importance of technology in the world in general. Again, this equivalence was maintained when the comparisons were made by subgroup.

As indicated in Table 7, students in both the United States and Thailand are interested in technology. The comparison shows that boys are more interested in technology than are girls in both countries. Students in both Thailand and the

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US think that technology is a field for both girls and boys. However, girls are even more convinced of this than are boys. Other similarities include:

1. In the Thailand study a positive influence of a parents' technological profession on the student's attitude was found, the same as the PATT-USA study.
2. As in the US study, it was found that Thai students' understanding of the concepts of technology increased with age.
3. The gender of the students had a significant effect on the attitude subscales of Interest, Role Pattern, and Difficulty in both countries.
4. Both Thai and US boys had a similar score on the concept items, whereas Thai girls (mean = .50) have a higher understanding of the concepts of technology than US girls (mean = .67).

Table 6
Results of One-Way ANOVAs On Demographic Characteristics

Characteristics	General Interest in Technology	Gender Difference	Consequences of Technology
Gender			
Boy	2.32	2.93	2.05
Girl	2.45	2.37	1.98
Significance	*	*	*
Have technical toys?			
No	2.47	2.71	2.03
Yes	2.38	2.64	2.01
Significance			
Have workshop at home?			
No	2.42	2.64	1.98
Yes	2.32	2.63	2.08
Significance			
Have personal computer?			
No	2.37	2.63	2.01
Yes	2.47	2.64	1.98
Significance			
Are you taking or have you taken TE/IA			
Done	2.35	2.56	1.95
Taking	2.34	2.60	2.02
Never	2.50	2.80	2.14
Significance	*	*	*

*alpha <= .01

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Table 7
Boys' and Girls' Scores on the Attitude and Concept Scales

		Interest	Pattern	Role Consequence	Difficulty	Curriculum	Career
Thailand (Bangkok)	Boys	2.32	2.93	2.05	2.04	2.17	2.40
	Girls	2.45	2.37	1.98	1.79	2.17	2.48
		*	*		*		
United States	Boys	2.50	2.30	2.00	2.70	-----	-----
	Girls	3.00	1.70	2.10	2.40	-----	-----
		*	*		*		

Concept Scales		Technology & Society	Technology & Science	Technology & Skills	Technology & Pillars	Total Scores
Thailand (Bangkok)	Boys	.57	.45	.50	.53	.51
	Girls	.58	.42	.49	.52	.50
United States	Boys	-----	-----	-----	-----	.50
	Girls	-----	-----	-----	-----	.67

* alpha <= .01

Conclusions

The overall conclusion of this study is that the Technology Attitude and Concept Scale for Thailand (TACS-Thai) is a valid and reliable instrument overall. The adaptation of the TACS-Thai instrument from the original TAS-US instrument and the translation from English to Thai was successful. The overall reliability estimate of the six attitude subscales in the pilot study was .74 and the overall reliability estimate of the concept scale was .72. It was concluded that the pilot study's attitude scale and concept scale had acceptable combined reliability. The content validity of the large group administration as judged by the panel of experts, the overall alpha value of .74 for the attitude scale, and the overall reliability estimate of .64 for the concept scale indicated that the TACS-Thai instrument could be used to ascertain the attitude towards and concepts of technology of secondary school students in Thailand. The TACS-Thai should be useful to Thai teachers, program planners, curriculum developers, and administrators at the secondary school level in Thailand.

These were differences in students' attitudes toward technology between the United States and Thailand. The differences can be attributed to culture and the educational system, especially the teacher-centered methodology used in the Thai classroom contributed to these differences. Overall, the patterns of attitudes and concepts of technology among the US and Thai students were similar based on the results of this study.

Recommendations

The results of this study suggest additional directions for consideration in future research. The following recommendations are offered.

1. It is recommended that an expanded number of secondary schools in Thailand be included in future research. As a basis for comparison of

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students' attitudes and concepts toward technology in different areas, it is recommended that future research expand the population of interest to include other cities in Thailand.

2. It is suggested that future research include the development of an upper secondary school TACS instrument and an elementary school TACS instrument. The research would help to determine the appropriateness of technology curriculum at the upper secondary school level and for learning reinforcement and technological awareness at elementary school level.
3. It is recommended that the scoring procedures of the instrument and an instruction manual for the teachers be developed. This instrument should be valuable for use by classroom teachers. The TACS-Thai instrument needs to be developed into a useable form, including instruments for administration, scoring, and analysis of results.
4. Future PATT researchers who want to translate and validate a Technology Attitude Scale for use in other countries should pay attention to the importance of language and culture of that specific country in order to be successful.
5. High school students in Thailand should take more technology education courses in order to help them learn more about technology and have more logical attitudes toward technology.

References

Ary, D., Jacobs, L. C. & Razavieh, A. (1985). *Introduction to research in education* (3rd ed.). New York: Holt, Rinehart and Winston.

Bame, E. A., Dugger, W. E., Jr., de Vries, M., & McBee, J. (1993). Pupils' attitudes towards technology-PATT-USA. *The Journal of Technology Studies, 6*(1), 40-48.

Cross, A., & McCormick, R. (1986). *Technology in schools.* Milton Keynes: Open University Press.

de Klerk Wolters, F. (1989). *The attitude of pupils towards technology.* Eindhoven, The Netherlands: Eindhoven University of Technology.

de Vries, M. J. (1987). *What is technology? The concept 'technology' in secondary education.* Unpublished manuscript. Department of Physics and Technology (N&T 87-01). Eindhoven, The Netherlands: University of Technology.

Gay, L. R. (1996). *Educational research: Competencies for analysis and applications* (5th ed.). Upper Saddle River, NJ: Merrill/Prentice Hall.

Jeffrey, T. J. (1993). *Adaptation and validation of a technology attitude scale for use by American teachers at the middle school level.* Unpublished doctoral dissertation, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement, 30*, 607-610.

McDaniel, E. (1994). *Understanding education measurement.* Benchmark, IA: Wm. C. Brown.

https://doi.org/10.21061/jte.v13i2.a.1

Mueller, D. J. (1986). *Measuring social attitudes: A handbook for researcher and practitioners.* New York: Teachers College Press.

Office of the National Education Commission. (1997). *Synopsis of the eighth national education development plan (1997-2001)*. Bangkok, Thailand: The author.

Raat, J. H. (1992). Technology education: A global perspective. In E. A. Bame, W. E. Dugger, & M. Sanders (Eds.). *Communication technology: today and tomorrow.* Mission Hills, CA:Glencoe/McGral-Hill.

van den Bergh, R. (1987). Results of PATT research in France, Denmark and the Netherlands. In R. Coenen-van den Bergh (Ed.). *Report: PATT Conference, vol. 2 contributions* (pp. 41- 51). Eindhoven, The Netherlands: University of Technology.