Pakistan Social Sciences Review *P-ISSN 2664-0422*
December 2019, Vol. 3, No.2 [785-794] *O-ISSN 2664-0430*

Pakistan Social Sciences Review
www.pssr.org.pk

RESEARCH PAPER

Confirmatory Factor Analysis of Pupils' Attitudes Towards Technology (PATT) Scales: A case of Pakistan

Dr. Tariq Hussain[1] Nisar Abid [2] Ehtisham Manzoor [3]

1. Assistant Professor, Institute of Education and Research, University of the Punjab, Lahore, Punjab, Pakistan
2. Ph. D Scholar, Institute of Education and Research, University of the Punjab, Lahore, Punjab, Pakistan
3. M. Phil. Scholar, Institute of Education and Research, University of the Punjab, Lahore, Punjab, Pakistan

PAPER INFO

Received:
November 17, 2019
Accepted:
December 25, 2019
Online:
December 31, 2019

Keywords:
Confirmatory Factor Analysis
Pupils' Attitudes towards Technology

Corresponding Author

tariq.ier@pu.edu.pk

ABSTRACT

The study seeks to investigate the psychometric properties of the Pupils' Attitudes Towards Technology (PATT) Scales in technical education institutes of Punjab, Pakistan. The philosophical paradigm of the study was positivism while descriptive research design of quantitative research approach was used to confirm the structure of PATT. 300DAE students were selected from nine technical education institutes of Punjab. Confirmatory Factor Analysis (CFA) was applied to confirm the structure of PATT Scales by using Smart-PLS 3. The results indicated that the value of Cronbach's alpha and composite reliability for the General Interest in Technology (GIT); Attitude Towards Technology (ATT); Consequences of Technology (CT); The Concept of Technology (TCT) were acceptable and greater than 0.70. Meanwhile, the convergent validity and discriminant validity of all the PATT Scales were adequate and higher than 0.5. It is recommended that administrators of Polytechnic Institutes and Colleges of Technology may identify the kind of students who wish to learn technical education by considering their attitude towards technology that might effect on future academic achievement.

Introduction

Attitude is not taken as a singular idea because it is a psychological construct that is comprised of many factors or dimensions (Ajzen, 2001). However, Ankiewicz (2016) believed that attitude has a connection with other non-cognitive variables. While Kalanda and Oliphant (2009) and Osman et al. (2003) demonstrated that students' positive attitude is a basic foundation for better learning. Therefore, researchers are interested to measure students' attitudes in many disciplines especially students' attitudes towards technology (Ankiewicz, 2016; Hussain, 2013;

Hussain & Akhter, 2016; Krueger et al., 2000). Hence, Pupils' Attitudes Towards Technology (PATT) scales have gained significant attention over the last three decades due to changes in technologies. Ankiewicz (2016) provided an overview that students' attitudes toward technology have probably been the work pioneered by Raat and De Vries (1987) as cited by (Ardies et al., 2015). The PATT instrument was the first instrument that was specifically designed to measure students' attitudes toward technology (Ardies et al., 2013; Hussain, Mahmood, & Nasreen, 2017).

Therefore, PATT Scale has received wide-spread attention since its conception. This scale has been used in numerous research studies over the years, scrutinizing its definitions, components, theoretical frameworks, and validation in various geographical regions (e.g. Ankiewicz et al., 2001; Ardies et al., 2013, 2015; Bame et al., 1993; Becker &Maunsaiyat, 2002; Raat& De Vries, 1987; Van Rensburg et al., 1999; Volk & Yip 1999). PATT and its related instrument have been used widely in Australia, Belgium, Finland, Hong Kong, Netherlands, Pakistan, Poland, South Africa, Sweden, Thailand, the United States of America, Turkey, and the United Kingdom. A questionnaire's underlying constructs are usually investigated through factor analysis. The same statistical functions have been used to study PATT. A type of Exploratory Factor Analysis (EFA), Principal Component Analysis (PCA) identifies the principal or main constructs of an under-construction questionnaire. However, the structure of PATT was not confirmed by researchers' using Confirmatory Factor Analysis (CFA). Using CFA usually enables researchers to further test the constructs of a validated survey questionnaire (Rohaan et al., 2010). Therefore, the current study was designed to confirm the structure of the PATT Scale in Pakistani technical education institutes.

Theoretical Framework

In 2012, a multilateral model of attitude toward science and technology was proposed by Van Aalderen-Smeets et al. (2012). This model replaced the dimension of behavior with perceived control. It was then rebuilt as an innovative attitudinal theoretical framework comprising of three different dimensions: Perceived control, Affective, and Cognitive. Moreover, Van Aalderen-Smeets et al. (2012) also suggested that attitude may be classified into two types; the first being personal attitude, while the second is professional attitude. The aforementioned model presented a comprehensive framework for research. This has been empirically and theoretically verified through a variety of contexts and fields (Thibaut et al., 2018; Suprapto &Mursid, 2017; Asma et al., 2011). Additionally, a wide number of researchers concerned with technology education referred to the model under discussion to examine the professional attitudes of teachers toward technology (Asma et al. 2011). Therefore, the theoretical framework provided by van Aalderen-Smeets et al. (2012) was used to examine students' attitudes toward technology.

Literature Review

An attitude can be defined as an individual's impression of any experience (Ajzen, 2001). Lavie et al. (2010) described it as a state or tendency, to act in a particular way. This same definition is maintained by McKenna et al. (2012), describing this in their research, as an act of value judgment of different elements of the social world (Barden & Hawkins, 2013). According to Ankiewicz (2016), the attitude is not a solitary ideological concept, but rather a psychological construct made up of several factors or dimensions (Cognitive, Affective, and Behavioral). Studies on students' perceptions toward technology have been conducted in many countries. Khunyakari et al. (2009) concluded that Pupils' Attitudes Towards Technology (PATT) contributed to the trend of an investigation into students' perception of technology across various cultures. However, Walters and McNeely (2010) found that students with a background in technical fields show a more positive attitude toward technology, and vice-versa. Meanwhile, Akpınar et al. (2009)found a positive correlation between students' attitudes towards technology with their academic achievement that latterly confirmed by Anwer et al. in 2012.

Conversely, Knezek and Christensen (2008) found that the attitude toward technology is consistent across groups of students of different ages.Van Aalderen-Smeets et al. (2012) investigated the attitudes of students toward science and its relationship with their science achievement at primary school. Theyfound that attitudes toward science are significantly affected by demographical variables such as gender, perception of parents' attitudes, socio-economic status of their families, their perception of science achievement. Al-Sad (2007) showed no effect of parents' education and profession on students' opinion. The researcher also concluded a positive attitude toward vocational education among students. Moreover, Becker and Maunsaiyat (2002) found that students with a background in technology scored significantly higher score in academic achievement.

Material and Methods

The philosophical paradigm was positivism while the quantitative research approach was adopted. However, a descriptive research design was used to confirm the structure of the Pupils' Attitudes Towards Technology (PATT) scales whereas a cross-sectional survey method was used to collect data about pupils' attitudes towards technology. The population was comprised of all the students enrolled in technical education institutions of Punjab. According to TEVTA, there are approximately 139475 students enrolled in all the technical education institutions of Punjab. While, two-stage sampling technique was used, at the first stage, the researchers' selected nine technical education institutes through a non-proportionate cluster stratified random sampling technique. Subsequently, average 35 students were selected from each selected institute through a simple random sampling technique. Hence, the sample was comprised of 315 students. Out of 315 students, 300 respond to PATT Scales. The Pupils' Attitudes Towards Technology (PATT) Scales was used to confirm the structure of PATT Scales. The researchersadopted

PATT Scales with the kind permission of its developer that developed in 1988 by Marc de Vries, Allen Bame, and William E. Dugger, Jr. The PATT Scales consisted of four sub-scales: i.e., General Interest in Technology (GIT), Attitude Towards Technology (ATT), Consequences of Technology (CT), The Concept of Technology (TCT). These four sub-scales comprised 44 items. The researcher personally visited the selected institutes and administered the PATT Scales with the permission of the principal and class teacher. Data were analyzed with the help of Smart-PLS 3. Confirmatory Factor Analysis (CFA) was applied to confirm the structure of Pupils' Attitudes Towards Technology (PATT) Scales.

Results and Discussion

Results of Confirmatory Factor Analysis

In Confirmatory Factor Analysis (CFA), the value of factor loading, cross-loading, Cronbach's Alpha, composite reliability, average variance extracted, and Fornell-Larcker criterion were calculated.

Table 1
Factor Loading, Cross-Loading, Cronbach's Alpha & Composite Reliability of Pupils' Attitude Towards Technology (PATT) Scales

	GIT	ATT	CT	TCT
GIT1	**0.807**			
GIT2	**0.781**			
GIT3	**0.823**			
GIT4	**0.803**			
GIT5	**0.797**			
GIT6	**0.723**			
GIT7	**0.824**			
GIT8	**0.742**			
GIT9	**0.784**			
GIT10	**0.713**			
GIT11	**0.801**			
GIT12	**0.732**			
GIT13	**0.718**			
ATT1		**0.843**		
ATT2		**0.702**		
ATT3		**0.714**		
ATT4		**0.725**		
ATT5		**0.761**		
ATT6		**0.703**		
ATT7		**0.803**		
ATT8		**0.817**		

ATT9		**0.872**		
ATT10		**0.851**		
ATT11		**0.903**		
CT1			**0.821**	
CT2			**0.845**	
CT3			**0.781**	
CT4			**0.832**	
CT5			**0.754**	
CT6			**0.803**	
CT7			**0.829**	
CT8			**0.872**	
TCT1				**0.812**
TCT2				**0.873**
TCT3				**0.745**
TCT4				**0.769**
TCT5				**0.831**
TCT6				**0.736**
TCT7				**0.902**
TCT8				**0.752**
TCT9				**0.823**
TCT10				**0.751**
TCT11				**0.887**
TCT12				**0.701**
Cronbach's Alpha	0.876	0.803	0.791	0.763
Composite Reliability	0.872	0.867	0.853	0.841

Note: GIT = General Interest in Technology; ATT = Attitude Towards Technology; CT = Consequences of Technology; TCT = The Concept of Technology.

The results show the value of Cronbach's alpha and composite reliability of each scale of PATT is more than 0.70. Cronbach's alpha for the General Interest in Technology (GIT); Attitude Towards Technology (ATT); Consequences of Technology (CT); The Concept of Technology (TCT) are 0.876; 0.803; 0.791; and 0.763 respectively. Whereas the composite reliability value of each scale of PATT is also higher than 0.70. However, the overall reliability of Pupils' Attitudes Towards Technology (PATT-Scales) was $\alpha = .837$. Moreover, the factor loading values of each item of each scale are higher than $\lambda > 0.50$ and significant at p-value < 0.001.

Table 2
Average Variance Extracted (AVE) and Fornell-Larcker Criterion for Pupils' Attitude Towards Technology (PATT-Scales)

	AVE	GIT	ATT	CT	TCT
GIT	0.583	0.737			
ATT	0.573	0.692	0.791		
CT	0.569	0.681	0.671	0.762	
TCT	0.563	0.572	0.632	0.620	0.741

Note: GIT = General Interest in Technology; ATT = Attitude Towards Technology; CT = Consequences of Technology; TCT = The Concept of Technology.

The table shows AVE values of all the scales of PATT are higher than 0.5 that indicates the presence of convergent validity. However, the values for the discriminant validity of each scale of PATT also higher than 0.5.

Discussions

The present research aimed to examine the structural analysis (convergent & discriminant validity and Cronbach alpha & composite reliability) of the Pupils' Attitudes Toward Technology (PATT) Scales. The researchers found that the Cronbach's alpha and composite reliability for General Interest in Technology (GIT), Attitude Towards Technology (ATT), Consequences of Technology (CT), The Concept of Technology (TCT) scale was acceptable while convergent validity and discriminant validity of PATT Scales was also good. Cronbach's alpha and composite reliability of each scale of PATT is more than 0.70. Whereas the composite reliability value of each scale of PATT is also higher than 0.70. However, the overall reliability of Pupils' Attitudes Toward Technology (PATT-Scales) was a = .837. Xu et al. (2018) found the KMO value for each attitude scales higher than 0.7 that supports the present study finding. The Cronbach's alpha value of the present study also aligned with previous studies on PATT scales (Chikasanda et al., 2011). Kay (2007) summarized key strategies for prospective teachers to familiarize them with the available technology. This might prove useful to improve students' attitudes. In 2002, Becker and Maunsaiyat illustrated that learners with a technical background displayed a better score, and vice-versa.

Conclusions and Recommendations

Pupils' Attitude Toward Technology (PATT) Scales comprised of four subscales: General Interest in Technology (GIT), Attitude Towards Technology (ATT), Consequences of Technology (CT), The Concept of Technology (TCT). Researchers are interested to examine the structural analysis (convergent & discriminant validity and Cronbach alpha & composite reliability) of the Pupils' Attitudes Toward Technology (PATT) Scales. Confirmatory Factor Analysis (CFA) was applied and conclusions are made based on the interpretations. It is determined from the CFA results Cronbach's alpha and composite reliability for GIT, ATT, CT, and TCT scale was acceptable while convergent validity and discriminant validity of

PATT Scales was also good. Curriculum planners may consider the study findings while deciding the development of content related to technology because student attitudes toward technology influence their future achievement. The administrators of Polytechnic Institutes and Colleges of Technology may identify the kind of students who want to get technical education by considering their students' attitude towards technology that might affect future academic achievement. For understanding, explanation, and implications of this study, more confirmation is required by conducting studies that include qualitative information through observations and interviews from students.

References

Ajzen, I. (2001). Nature and operation of attitudes. *Annual Review of Psychology*, *52*(1), 27-58.

Akpınar, E., Yıldız, E., Tatar, N., &Ergin, Ö. (2009). Students' attitudes toward science and technology: an investigation of gender, grade level, and academic achievement. *Procedia-Social and Behavioral Sciences*, *1*(1), 2804-2808.

Al-Sad, A. (2007). *Evaluation of students' attitudes towards vocational education in Jordan* (Doctoral dissertation, Lärarutbildningen, Malmö högskola).

Ankiewicz, P. (2016). Perceptions and attitudes of pupils toward technology. *Handbook of technology education, Springer International Handbooks of Education, https://doi. org/10.1007/978-3-319-38889-2_43-1*.

Ankiewicz, P., Van Rensburg, S., &Myburgh, C. (2001). Assessing the attitudinal technology profile of South African learners: A pilot study. *International Journal of Technology and Design Education*, *11*(2), 93-109.

Anwer, M., Iqbal, H. M., & Harrison, C. (2012). Students' attitude towards science: A case of Pakistan. *Pakistan Journal of Social and Clinical Psychology*, *9*(2), 3-9.

Ardies, J., De Maeyer, S., &Gijbels, D. (2013). Reconstructing the pupils' attitude towards technology-survey. *Design and Technology Education*, *18*(1), 8-19.

Ardies, J., De Maeyer, S., Gijbels, D., & van Keulen, H. (2015). Students' attitudes towards technology. *International Journal of Technology and Design Education*, *25*(1), 43-65.

Asma, L., Van Der Molen, J. W., & van Aalderen-Smeets, S. (2011). Primary teachers' attitudes towards science and technology: Results of a focus group study. In *Professional development for primary teachers in science and technology* (pp. 89-105). Brill Sense.

Bame, E. A., Dugger, W. E., de Vries, M., &McBee, J. (1993). Pupils' attitudes toward technology—PATT-USA. *The Journal of Technology Studies*, *19*(1), 40-48.

Barden, K., & Hawkins, S. (2013). Perceptual learning of phonetic information that indicates morphological structure. *Phonetica*, *70*(4), 323-342.

Becker, K. H., &Maunsaiyat, S. (2002). Thai Students' Attitudes and Concepts of Technology. *Journal of Technology Education*, *13*(2), 6-20.

Chikasanda, V. K. M., Williams, P. J., Otrel-Cass, K., & Jones, A. (2011). Students' perceptions towards technology (PATT): A professional development tool for technology teachers.

Hussain, T. (2013). *Relationship between attitude of students and their achievement in technical education* (Doctoral dissertation, University of the Punjab, Lahore).

Hussain, T., & Akhter, M. (2016). Students' Attitude towards Technology: A Study from Pakistan. *Bulletin of Education and Research*, *38*(1), 17-30.

Hussain, T., Mahmood, K., & Nasreen, A. (2017). Effect of Students Attitude towards Technology on their Academic Achievement. *Pakistan Social Sciences Review, 1*(1), 135-146.

Kalanda, K., & Oliphant, J. (2009, October). Factors influencing students' attitude towards technology. In *E-Learn: World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education* (pp. 2735-2741). Association for the Advancement of Computing in Education (AACE).

Kay, R. (2007). A formative analysis of how preservice teachers learn to use technology. *Journal of Computer Assisted Learning*, *23*(5), 366-383.

Khunyakari, R., Mehrotra, S., Natarajan, C., &Chunawala, S. (2009, January). Studying Indian middle school students' attitudes towards technology. In *Proceedings of the International Conference to Review Research in Science, Technology and Mathematics Education-epiSTEME-3* (pp. 5-9).

Knezek, G., & Christensen, R. (2008). The importance of information technology attitudes and competencies in primary and secondary education. In *International handbook of information technology in primary and secondary education* (pp. 321-331). Springer, Boston, MA.

Krueger Jr, N. F., Reilly, M. D., &Carsrud, A. L. (2000). Competing models of entrepreneurial intentions. *Journal of Business Venturing*, *15*(5-6), 411-432.

Lavie, T., Sela, M., Oppenheim, I., Inbar, O., & Meyer, J. (2010). User attitudes towards news content personalization. *International journal of human-computer studies*, *68*(8), 483-495.

McKenna, M. C., Conradi, K., Lawrence, C., Jang, B. G., & Meyer, J. P. (2012). Reading attitudes of middle school students: Results of a US survey. *Reading research quarterly*, *47*(3), 283-306.

Osman, K., Halim, L., &Ikhsan, Z. H. (2003). The critical thinking attitudinal profile of some Malaysian secondary students: A reflection of scientific attitudes. *Journal of Science and Mathematics Education in Southeast Asia*, *26*(2), 143-166.

Raat, J. H., & de Vries, M. (1987). Technology in education: Research and development in the project 'Physics and Technology'. *International Journal of Science Education*, *9*(2), 159-168.

Rohaan, E. J., Taconis, R., &Jochems, W. M. (2010). Reviewing the relations between teachers' knowledge and pupils' attitude in the field of primary technology education. *International journal of technology and design education*, *20*(1), 15-26.

Suprapto, N., &Mursid, A. (2017). Pre-Service Teachers' Attitudes toward Teaching Science and Their Science Learning at Indonesia Open University. *Turkish Online Journal of Distance Education*, *18*(4), 66-77.

Thibaut, L., Knipprath, H., Dehaene, W., &Depaepe, F. (2018). The influence of teachers' attitudes and school context on instructional practices in integrated STEM education. *Teaching and teacher education*, *71*, 190-205.

Van Aalderen-Smeets, S. I., Walma van der Molen, J. H., & Asma, L. J. (2012). Primary teachers' attitudes toward science: A new theoretical framework. *Science education*, *96*(1), 158-182.

Van Rensburg, S., Ankiewicz, P., &Myburgh, C. (1999). Assessing South Africa learners' attitudes towards technology by using the PATT (Pupils' Attitudes Towards Technology) questionnaire. *International Journal of Technology and Design Education*, *9*(2), 137-151.

Volk, K. S., & Yip, W. M. (1999). Gender and technology in Hong Kong: A study of pupils' attitudes toward technology. *International Journal of Technology and Design Education*, *9*(1), 57-71.

Walters, J., & McNeely, C. L. (2010). Recasting Title IX: Addressing gender equity in the science, technology, engineering, and mathematics professoriate. *Review of Policy Research*, *27*(3), 317-332.

Xu, M., Williams, J. P., & Gu, J. (2018). An initial development and validation of a Chinese technology teachers' attitudes towards technology (TTATT) scale. *International Journal of Technology and Design Education*, 1-14.