Structural Equation Model of Students Attitudes and Evaluation of Teachers' Performance in the Research Course

Garnette Mae V. Balacy, MSAM

ABSTRACT

This study investigated the causal relationship between Evaluation of Teachers by students (ETS) and the Attitudes towards Research (ATR). Structural equation modeling (SEM) was the research approach because the ATR factors and ETS were considered latent constructs. The participants were 208 graduating students from the University of Mindanao, Digos Campus who had recently undergone their Research Course. In data gathering, the Attitude towards Research Scale by Papanatasiou and the latest Evaluation of Teachers by Students (ETS) were utilized. Confirmatory factor analysis using maximum likelihood estimation was used in the measurement model. This study explored four structural models. The hypothesized model A was a five-factor ATR and a three-factor ETS. Evaluation of this model was done using fit indices like CMIN/DF, CFI, TLI, GFI and RMSEA and revealed the inability of the model to fit the empirical data of this study. Three models were developed as guided by theory and parameter estimates. Model B suggested a five-factor ATR and a one-factor ETS. Model C represented a five-factor ATR with covariances and a one-dimensional ETS. Finally, Model D proposed a related two-factor ATR and a one dimensional ETS. Comparative evaluation of the models was carried out by looking at the model fit indices. It was found that model D best fits the data. This model suggests that students' evaluation of their Research teachers is significantly determined by their attitudes towards the Usefulness of Research and its Difficulty. It is suggested that Research teachers address those issues during the courses on Research.

Keywords: *attitudes towards research, evaluation of teachers by students, structural equation modeling*

INTRODUCTION

Defining and measuring teaching effectiveness plays an important role in many of the decisions made in higher education. Teachers may be evaluated by administrators, peers, students and even self. But with the surge of public demand for accountability in higher education institutions and the great concern for quality of university teaching, collecting student ratings has been widely adapted (Karasar, 2000). This evaluation of teachers relies heavily on inferences made by students about the quality of performance, observed teaching styles and behavior (Wright and O'Neil, 1992). In the Research course, teachers are evaluated by students in terms of: possessing and manifesting the scientific method, having the technical information, skills and attitudes required, and an understanding of its place in individual and social life.

Since student ratings are used as the primary measure of teaching performance, active participation and meaningful input from students are critical factors. Edward Lee Thorndike theorized that attitudes determine a learner's decisions or actions. According to Kagitcibasi (1999), attitude is a tendency attributed to an individual that constitute his thought, feelings and behavior concerning a psychological object in an organized manner. The concept of attitude forms the basis of explaining our thoughts and ideas, as attitude is a cognitive, perceptive and behavioral pre-tendency reaction of an individual.

Research can be viewed in a number of ways: as a mere tool used to expand knowledge (Marczyk, 2005), as a process of data collection, analysis, and interpretation (Demirel, 2003), or as an end in itself which in turn guides advances in academic and practical disciplines (Brew, 2001).

Students at the undergraduate level tend to view research methods courses negatively (Papanastasiou & Zembylas, 2008). Although a number of instruments that measure attitudes already exist, they all differ in content and configuration. Some represent attitudes as a construct with six indicators or factors, while other regard it as one-dimensional which hypothesize that no meaningful domains exists within attitudes. The identification of the factors that form the structure of the student attitudes toward a research methods course may bear important theoretical and practical implications.

The students' attitudes towards research may be associated to the evaluation of performance of the teachers handling this Research subject as a compulsory undergraduate requirement. Since student ratings are used as the primary measure of teaching effectiveness, active participation and meaningful input from students are critical factors in the success of a teaching evaluation system. Several studies in the educational area have observed a significant link between student attitudes and the teaching evaluation system (Hofman & Kremer, 1980). Hence the researcher deems it necessary to also measure the performance of the research subject teachers.

In the present setting at the University of Mindanao Digos College (UMDC), Evaluation by Teachers by Students (ETS) is conducted every semester to gauge college instructors' performance in the classroom using an instrument with identified domains of competency like professional characteristics or traits, knowledge of the subject matter, teaching strategies and methodologies and classroom management. However, this instrument is applicable only to lecture-type of courses wherein the teacher regularly conducts classes. The set-up for research courses is different in a way that there is a lesser amount of quizzes and exams since the grading system is based on the output of the students in the form of thesis manuscript. The research teachers would have low ratings for other items in the present instrument for evaluation of teachers because these items are not applicable to them. There are also other important aspects of the research subjects not captured in this instrument like consultation and monitoring. Thus, there is a need for a new instrument in evaluating the research teachers. The latent variables that have yet to be identified are to be considered as dimensions.

An understanding of these variables is necessary to help instructors facilitate the learning of research for their students. This study attempted to confirm the attitudes towards research (ATR) scale developed by Papanastasiou (2005) namely usefulness of research, anxiety, positive feelings about research, life relevancy and difficulty of research for UMDC students. Confirmatory Factor Analysis was also performed to characterize the factors of Evaluation of Teachers by Students (ETS) questionnaire with the dimensions knowledge, skills and attitudes. A factor structure showing the relatedness of these variables was also constructed using structural equation modeling (SEM).

The objects measured in the social sciences are usually multivariate as numerous variables are used to characterize objects. Other multivariate techniques can only use observed measurements. However, in the real world, there are variables that are unobserved in nature, which means that they can only be identified through manifest variables. For this structural equation modeling (SEM) is a better approach to multivariate data analysis. In this study, the factors of attitudes towards research and evaluation of teachers by students are not yet observed and measured. SEM allows studying complex relationships among variables both observed and unobserved.

It is model based, which tells that when there are more than one competing models, SEM can show which ones fit, where there are redundancies and can help pinpoint what particular model aspects are in conflict with the data.

Factor Analysis (FA) frequently serves as the measurement portion in SEM. In fact, SEM combines factor analysis and multivariate regression models. However this study is different from other studies using FA and SEM because this study aims to understand SEM and apply the models to the data on students' attitudes towards research and evaluation of teacher's performance at UMDC. .

Statement of the Problem

The main purpose of this study is to investigate the causal relationship between the factors of attitudes towards research (ATR) and the Evaluation of Teachers by students (ETS). This research also aimed to introduce the concept and procedure involved in structural equation modeling (SEM). Specifically, it aims to:

1. Apply factor analysis to students' attitude towards research (ATR);
2. Apply factor analysis to evaluation of teachers by students (ETS); and
3. Conduct Structural Equation Modeling (SEM) to establish causal relationship between ATR and ETS.

FRAMEWORK

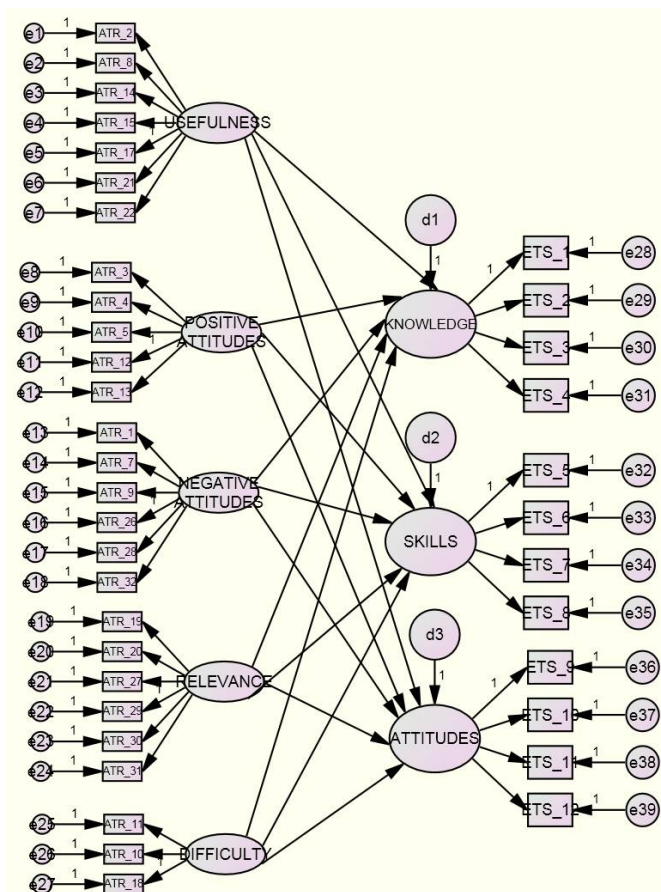Figure 1. Hypothesized Structural Model

Figure 1 illustrates the conceptual framework of the study. The model represents the relationship between the endogenous variables which are the factors of the Evaluation of Teachers by Students (ETS) and the exogenous variables, which are the attitudes towards research (ATR).

In the diagram, confirmatory factor analyses (CFA) are performed to verify the factors identified for the Attitudes towards Research (ATR) and Evaluation of Teachers by Students (ETS). In each CFA, the indicators that are heavily loaded to each factor are determined. This will confirm whether the factor structure developed by Papanastasiou (2005) will fit the empirical data of this study. Furthermore, this study also would determine which indicators are heavily loaded to knowledge, skills, and attitudes of the Evaluation of Teachers by Students (ETS).

Moreover, the relatedness between the factors of the attitudes towards research and the ETS are to be identified as

a set of simultaneous regression equations. Though it is not certain if the present data set would confirm the indicators, it is also not guaranteed that the factors or dimensions of the students Attitudes towards Research would significantly predict ETS.

The measurement model of ATR and ETS is the factor analytic part of SEM. The variables obtained from the analysis are denoted in Table 1.

Table 1. Index of Variables

Notation	Description
η_i	Evaluation of Teachers by Students (ETS) , the latent endogenous variable(s), $1 \leq i \leq 3$
ξ_i	Attitudes towards research factor, one of the five latent exogenous variables, $1 \leq i \leq 5$
λ_x	Path coefficients(factor loadings) relating indicators to factors in ATR, $1 \leq x \leq 25$
δ_y	Path coefficients (factor loadings) relating indicators of ETS to the single construct $1 \leq y \leq 12$
D	Structural disturbance
Bi	Structural coefficients relating ETS to ATR factors, $1 \leq i \leq 5$
ETS_y	Indicators of ETS, $1 \leq y \leq 12$
ATR_x	Indicators of ATR, $1 \leq x \leq 27$
e_x	Measurement errors, $1 \leq x \leq 27$ for ATR and $28 \leq y \leq 39$ for ETS
e_y	

Hence the general measurement models are represented by

$$ATR\_x = \lambda_x \xi_i + e_x$$

$$ETS\_y = \delta_y \eta + e_y$$

and the general structural models are represented by

$$\eta = \beta_0 + \beta_i \xi_i + d$$

METHODS

Research Design

This study utilized the non-experimental quantitative research design. This was used to develop and employ mathematical models, theories and hypothesis pertaining to phenomena (Given, 2008). This nature is also exhibited by the use of empirical data in the interval level of measurement from participants' responses in the ATR and evaluation of teachers by students (ETS).

This study also focused on fitting the data to hypothesized models of students' attitudes towards research and their evaluation of research teacher's performance. Hence, causal design was employed to describe the relationships among the observed and latent variables of the study.

Research Procedure

The participants of the study are college students of UMDC who have finished their Research subject and have accomplished their final thesis defense. A total of 208 were selected from the six main departments namely CBA, Education, IT, Nursing, Liberal Arts and Criminology. SEM needs to be large to get stable estimates of the covariances/correlations. This means 200 subjects for small to medium sized model and a minimum of 10 subjects per estimated parameter. Hence, the researcher employed universal sampling to satisfy the size requirement of SEM.

The data gathering part of this study involved the letter of permission to the Director of the UMDC for the conduct of survey. Upon approval, distribution and retrieval of questionnaires was done. Responses from the two research instruments were then collated, analyzed and interpreted.

However, this paper aims to present the procedure in structural equation modeling, which is a body of statistical techniques. Hence the analysis underwent the process involved in SEM studies namely; specification, identification, selection of measures and data preparation, estimation, evaluation and modification. Figure 2 below presents the steps.
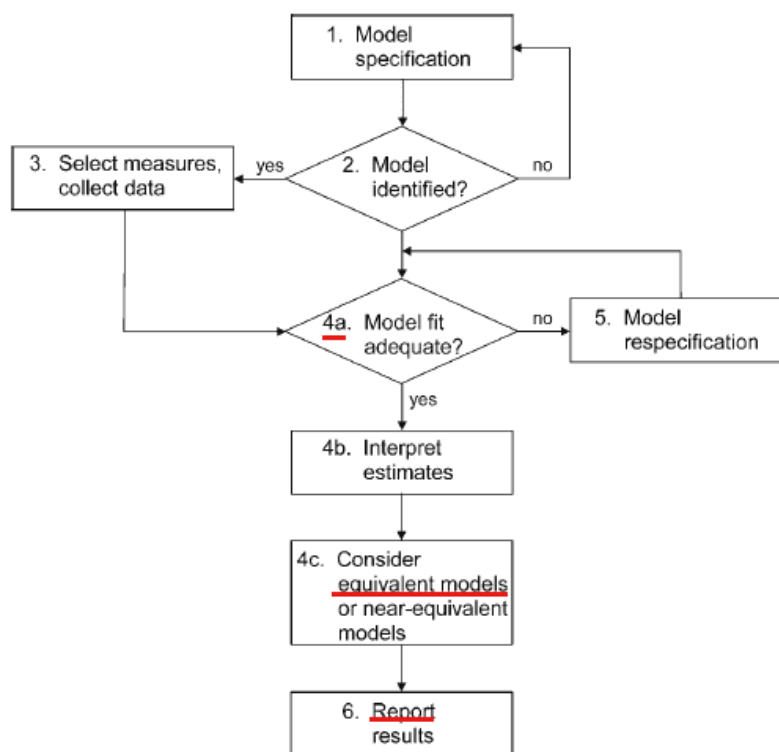

Figure 2. Flowchart of the Basic Steps of SEM

The SEM procedure in Figure 2 was used in this study and can be briefly described as follows. In model specification, the research hypothesis is represented in the form of a hypothesized model, which is a diagram showing the factors of ATR and ETS and their connectedness. Standard graphical symbols in path analysis are used or a series of equations can be formed which correspond to presumed relations among latent factors and indicators. Next is model identification which is determining whether it is theoretically possible for the computer to derive a set of model parameter estimates. When the model was determined to be just identified, the data was prepared. In the process of selection, assumptions have to be established for the data like normality, absence of outliers and absence of multicollinearity. Several statistical measures were implemented to correct the data in case the assumptions were not met. In model estimation,

AMOS was used to run the model and verify the fit using indices like Chi-square, CFI, TLI, GFI and RMSEA. Model modification followed based on the standardized parameter estimates and modification indices. The final model has the most appropriate fit to the empirical data.

Research Instrument

This study utilized primary data collected from two different questionnaires. One of the instruments for data gathering is the ATR scale developed by Papanastasiou (2005), which contains 32 items regarded as the observed variables in this study. The items are listed on a 7-point Likert scale. The score 1 represented the option "strongly disagree" while the option 7 on the scale represented strongly agree. This instrument by Papanastasiou (2005) was checked for reliability wherein the Cronbach's alpha for the five factors were all greater than 0.7.

Another questionnaire on the evaluation of teachers by students (ETS) was developed by the research coordinators of the University of Mindanao on February 11, 2014 as a way of modifying the present ETS which is not applicable to research courses. This is made up of 12 items reflecting the qualities of a good research teacher. The responses were described by level of manifestation in terms of frequency. The following is the response mode:1-never, 2-seldom, 3-sometimes, 4-most of the time and 5-always.

The Analysis of Moment Structures (Amos) by Arbuckle (1195-2000) was the computer software used in this study. The researcher was able to get a trial version from the internet. It is a Microsoft Windows program sold by SPSS, Inc. as either a stand-alone application which means it doesn't need SPSS to run or as an optional part of SPSS. The version number of Amos reflects the current version number of SPSS. The Amos program is made up of two modules, Amos Graphics and Amos Basic. Amos Graphics provide a graphical user interface (GUI) through which the user can specify the model by drawing it on screen and control the aspects of the analysis. A set of graphical wizards is available that can automatically draw an entire latent growth model, among other tasks. A special utility for testing alternative models is available through the specification search toolbar. In this utility the user can designate particular paths in the model as optional and Specification Search will analyze models with all possible subsets of the designated paths. Values of fit statistics for all tested models appear in a summary table, and the corresponding model diagram can be viewed by clicking the mouse cursor in the table (Kline, 2011). There are free student versions that place a limit on the size of the model or the number of variables that can be analyzed.

Data Analysis

Mahalanobis distance referred to as the D statistic, indicates the distance in standard deviation units between a set of scores for an individual case and the sample means for all variables. In AMOS, the first column in the output reflects the observation number farthest from the centroid, with a probability value p1. If p1<0.001, the null hypothesis is rejected, which means that the observation may be an outlier. (Kline, 2011)

Skew Index (SI) indicates the direction of the skew whether positive or negative. It is calculated as $SI = S^3/(S^2)^{3/2}$, where S^2, and S^3 are the second and third moments about the mean. Variables with absolute values of SI > 3.0 are described as extremely skewed (Kline, 2011).

Kurtosis Index (KI) indicates the type of kurtosis whether positive or negative. Absolute value of KI greater than 10 suggests problems on extreme kurtosis. $KI = S^4/(S^2)^2 - 3$ where S^2 and S^4 are the second and fourth moments about the mean (Kline, 2011).

Tolerance is the amount of variability of the selected independent variable not explained by the other independent variables. It is obtained by making each independent variable a dependent variable and regressing it against the remaining independent variables.

Tolerance values approaching zero indicate that the variable is highly collinear with the other predictor variables. Tolerance values less than 0.1 indicate extreme multicollinearity (Kline, 2011).

Kaiser-Meyer-Olkin is a measure of sampling size adequacy. This measure should be greater than absolute value of 0.50 for a satisfactory factor analysis to proceed.

Bartlett's Test of Sphericity tests the null hypothesis that the original correlation matrix is an identity matrix. This test has to be significant, i.e., p-value should be less than 0.05. This indicates that when the correlation matrix is an identity matrix, there would be no correlations between the variables, which would indicate that the factor model is not appropriate (Akgül, 2005).

Covariance represents the strength of the association between two continuous observed variables. It is the basic statistic of SEM and is unstandardized.

From the numerous goodness of fit measures used in SEM, all were designed to provide information about how well the data fits the data in your dataset. Only five were selected to be used in this study. The selection was made based on the most commonly-used and generally-accepted fit measures used by researchers having similar studies. The fit measures allow the research to test whether the hypothesis about the nature of the web of relationships is accurate. Among the selected measures used in this study were:

1. **Chi-square over Degree of Freedom (CMIN/DF)** or relative chi-square, which is an index of how much the fit of data to model has been reducing by dropping one or more paths, must have a value not exceeding 3 to obtain a good model fit (Wuensch, 2007).

2. **The Goodness of Fit Index (GFI)** equals one minus the ratio of the residual weighted sum of squares (using elements of S – Σ) over the total weighted sum of squares (using elements of S), where the weights are as in the fit function. This index is directly analogous to R^2 in ordinary regression. GFI tells the proportion of variance-covariance matrix accounted for by the model which should exceed .9 for a good model.

3. **Tucker-Lewis Index (TLI)** is a much robust index, which is the percentage change in the square which tells the difference between the two models chi-squares divided by the chi-square for the independence model the desired index is .90 (Bentler & Bonett, 1980).

4. **Comparative Fit Index (CFI)** is said to be a good fit index for small samples. When the model is correct, the expected value of the test statistic is its degree of freedom, when the model is not correct, the expected value of the test statistic is approximately the degrees of freedom plus the non-centrality (a parameter of the chi-square distribution usually indicated by λ). The CFI index can be thought of as a measure of relative non-centrality between the tested model and the independence model, like TLI, specifies value of .90 for a good fit model.

5. **Root Mean Square Error of Approximation (RMSEA)** is currently the most popular measure of model fit reported in virtually all papers that use SEM (MacCallum, Browne, & Sugawara, 1996). Values 0.01, 0.05 and 0.08 for RMSEA indicate excellent, good and mediocre fits, respectively. It measures the average amount of misfit in the model per degree of freedom. In practice, RMSEA and CFI are often used together to judge models, a popular criterion is to accept models that have CFI > 0.90 and RMSEA < 0.05. Hu & Bentler (1999) recommend a more stringent CFI > 0.95 and a less stringent RMSEA < 0.06. P of close fit (PCLOSE) is a one-sided test of the null hypothesis stating that the RMSEA of the model equals to 0.05. It implies that when the *p* is greater than the 0.05 (i.e. not statistically significant), then it is concluded that the fit of the model is "close" (Kenny, 2014).

RESULTS AND DISCUSSION

Apply confirmatory factor analysis to students' attitude towards research (ATR)

The sample size in this modeling approach is important because it relates to the stability of the parameter estimates. For one sample analysis, there is no exact rule for the number of participants needed; but a sample size of at least 200 appears to be the general consensus. In this study, 208 graduating students of the UMDC were the respondents.

Outliers were also determined by looking into extreme values per item. Outliers are scores that are different from the rest. A common rule is that the scores more than three standard deviations beyond the mean are considered outliers. In this study, Mahalanobis distances were used to detect multivariate outliers. It was found that there are cases that are believed to be significantly out of the norm, however, they were not ruled out since the sample size would be less than 200.

On the normality assumption, only univariate normality was measured. The absolute values of the skewness index and kurtosis index were utilized. The guideline used is that variables with absolute values of skewness greater than 3 are described as extremely skewed while kurtosis value greater than 8 indicates extreme kurtosis (Kline, 2011). It was found that the items of both ATR and ETS are approximately normal. Thus the data used in this study can be approximated to have a multivariate normal distribution.

Since the data set was found to be approximately normal, the maximum likelihood method was used for estimation.

Table 2. Test for Outliers
Observations farthest from the centroid (Mahalanobis distance) (Group number 1)

Observation number	Mahalanobis d-squared	p1	p2
143	86.569	.000	.006
15	81.683	.000	.000
140	76.502	.000	.000
124	75.702	.001	.000
1	74.998	.001	.000
100	74.614	.001	.000
142	73.851	.001	.000
19	72.108	.001	.000
102	66.659	.005	.000
112	66.424	.005	.000
22	64.489	.008	.000
97	63.118	.011	.000
56	62.659	.013	.000
153	62.659	.013	.000
43	62.615	.013	.000
107	62.136	.014	.000
81	61.768	.015	.000
111	61.749	.015	.000
25	59.337	.025	.000
105	58.866	.028	.000
110	58.270	.031	.000
83	58.172	.032	.000
13	58.073	.032	.000
71	56.492	.044	.000
168	56.492	.044	.000
2	55.540	.052	.000
138	55.265	.055	.000
179	55.265	.055	.000
77	54.751	.060	.000

Observation number	Mahalanobis d-squared	p1	p2
205	54.751	.060	.000
33	54.433	.064	.000
195	54.433	.064	.000
133	54.067	.068	.000
174	54.067	.068	.000
132	54.044	.068	.000
173	54.044	.068	.000
79	53.772	.072	.000
207	53.772	.072	.000
65	52.305	.092	.000
162	52.305	.092	.000
39	52.168	.094	.000
201	52.168	.094	.000
29	50.832	.117	.000
191	50.832	.117	.000
129	50.521	.123	.000
94	50.466	.124	.000
28	49.965	.134	.000
190	49.965	.134	.000
10	49.621	.142	.000
187	49.621	.142	.000
8	48.705	.163	.001
186	48.705	.163	.001
106	48.258	.174	.002
88	47.968	.181	.003
103	47.934	.182	.002
21	47.784	.186	.002
78	47.683	.189	.002
206	47.683	.189	.001
96	46.770	.214	.011
92	46.714	.216	.008
90	46.710	.216	.006
40	46.602	.219	.005
202	46.602	.219	.003
47	46.282	.229	.005
74	45.060	.268	.089
82	44.949	.272	.085
113	44.693	.281	.109
66	44.607	.284	.100
163	44.607	.284	.076
109	44.596	.285	.058
127	44.089	.303	.129
64	43.929	.309	.137
161	43.929	.309	.107
115	43.340	.331	.244
26	43.072	.341	.301
123	42.809	.352	.363
89	42.743	.354	.338
3	42.632	.359	.335
181	42.632	.359	.284
54	42.199	.376	.426
151	42.199	.376	.371
57	40.575	.445	.939
154	40.575	.445	.920
134	40.446	.451	.923
175	40.446	.451	.901
38	40.077	.467	.947
200	40.077	.467	.930

Observation number	Mahalanobis d-squared	p1	p2
17	39.972	.472	.929
41	39.544	.491	.970
69	38.813	.524	.996
166	38.813	.524	.995
60	38.444	.540	.998
157	38.444	.540	.997
126	37.979	.562	.999
34	37.768	.571	1.000
196	37.768	.571	.999
62	37.515	.583	1.000
159	37.515	.583	1.000
73	36.976	.607	1.000
170	36.976	.607	1.000

Table 3: Test for Normality
Assessment of normality (Group number 1)

Variable	Min	max	skew	c.r.	kurtosis	c.r.
ATR_9	1.000	6.000	.266	1.569	-.479	-1.410
ATR_20	2.000	7.000	-.622	-3.664	-.544	-1.600
ETS_12	1.000	5.000	-.748	-4.403	-.336	-.988
ETS_11	1.000	5.000	-.640	-3.767	-.348	-1.023
ETS_10	1.000	5.000	-.820	-4.831	.571	1.680
ETS_9	1.000	5.000	-.873	-5.139	.507	1.494
ETS_8	1.000	5.000	-.642	-3.782	-.182	-.535
ETS_7	1.000	5.000	-.306	-1.804	-.602	-1.772
ETS_6	1.000	5.000	-.847	-4.987	.625	1.839
ETS_5	1.000	5.000	-.630	-3.707	.112	.330
ETS_4	1.000	5.000	-.521	-3.066	-.391	-1.152
ETS_3	2.000	5.000	-.328	-1.930	-.981	-2.889
ETS_2	1.000	5.000	-.793	-4.671	.446	1.313
ETS_1	1.000	5.000	-.501	-2.948	-.536	-1.577
ATR_11	1.000	7.000	.400	2.355	-.197	-.579
ATR_10	1.000	7.000	.120	.704	-.703	-2.071
ATR_18	1.000	7.000	.308	1.815	-.521	-1.533
ATR_19	1.000	7.000	-.120	-.704	-.693	-2.040
ATR_27	2.000	7.000	-.154	-.905	-.779	-2.293
ATR_29	2.000	7.000	-.234	-1.378	-.720	-2.119
ATR_30	1.000	7.000	-.314	-1.849	-.304	-.894
ATR_31	2.000	7.000	-.424	-2.494	-.597	-1.759
ATR_1	1.000	7.000	.075	.442	-.855	-2.517
ATR_7	1.000	7.000	.100	.590	-.843	-2.481
ATR_6	1.000	6.000	-.041	-.243	-.578	-1.700
ATR_26	1.000	7.000	-.414	-2.437	-.351	-1.033
ATR_28	1.000	7.000	.590	3.476	-.588	-1.731
ATR_32	1.000	7.000	.587	3.454	-.333	-.980
ATR_3	1.000	7.000	-.449	-2.647	.085	.251
ATR_4	2.000	7.000	-.493	-2.900	-.419	-1.234
ATR_5	1.000	7.000	-.601	-3.536	.426	1.255
ATR_12	1.000	7.000	-.491	-2.893	-.037	-.108
ATR_13	1.000	7.000	-.350	-2.063	-.664	-1.956
ATR_2	2.000	7.000	-1.220	-7.183	.437	1.287
ATR_8	1.000	7.000	-.969	-5.704	.379	1.115
ATR_14	1.000	7.000	-.993	-5.845	.317	.933
ATR_15	1.000	7.000	-.879	-5.177	.230	.676
ATR_17	1.000	7.000	-.737	-4.340	.053	.155
ATR_21	1.000	7.000	-1.103	-6.493	.680	2.002
ATR_22	1.000	7.000	-.837	-4.930	.440	1.297
Multivariate					123.072	15.311

Table 4 presents the results of the dimension reduction of the items of the Student Attitudes towards Research using SPSS trial version. Kaiser-Meyer-Olkin (KMO) and the Bartlett's tests were looked into and were used to preliminarily identify possibility of factorability of the Attitudes towards Research scale. With the factor analysis conducted on the data obtained from the scale, the KMO measure was found to be more than adequate (0.855).

Table 4: Factor Analysis Results of ATR Data

Items		Factors				
		1	2	3	4	5
ATR_2	Research should be taught to all students	0.482				
ATR_8	Research is useful for my career	0.629				
ATR_14	Research is connected to my field of study	0.702				
ATR_15	Most students benefit from research	0.687				
ATR_17	Research is very valuable	0.756				
ATR_21	Research is useful	0.742				
ATR_20	The skills that I have acquired in Research will be helpful to me in the future.	0.742				
ATR_22	Knowledge from research is as useful as writing	0.757				
ATR_3	I enjoy research		0.701			
ATR_4	Research is interesting		0.764			
ATR_5	I like research		0.586			
ATR_12	I love research		0.668			
ATR_13	I am interested in research		0.719			
ATR_1	Research makes me anxious			0.534		
ATR_7	Research scares me			0.411		
ATR_6	I feel insecure concerning the analysis of research data			0.410		
ATR_26	Research thinking does not apply to my personal life			-0.585		
ATR_28	Research is difficult			0.677		
ATR_32	Research is a complex subject			0.532		
ATR_19	I use research in my daily life				0.602	
ATR_27	I will employ research approaches to my work				0.629	
ATR_29	I am inclined to study the details of research procedures carefully				0.481	
ATR_30	Research is pleasant				0.585	
ATR_31	Research-oriented thinking plays an important role in my daily life				0.677	
ATR_9	I find it difficult to understand the concepts of research.					0.573
ATR_10	I make many mistakes in research					0.679
ATR_11	I have trouble with arithmetic					0.663
ATR_18	Research makes me nervous					0.496
	Eigenvalue	9.275	3.87	2.1	1.554	1.276
	% variance	33.126	13.81	7.52	5.55	4.56
	Reliability by Cronbach's	0.912	0.908	0.917	0.844	0.815
	Cronbach α = 0.805 KMO = 0.855 Bartlett's Test of Sphericity Chisquare = 3663.74, p < 0.001					

On the other hand, Bartlett's test of sphericity, Barlett's coefficient, with its associated probability of less than 0.05 (0.000), was determined to be significant. This means that the correlation matrix is not an identity matrix. The results of the KMO and Bartlett's tests indicated that a factor analysis could be performed on the data.

Next, the maximum likelihood method of estimation using the orthogonal VARIMAX method of rotation was run, suggesting the presence of five factors with eigenvalues greater than one. These factors together explained 64.56 percent of the total variance. The criteria by Hair, et al (1998) for assessing the practical significance of standardized factor loadings were applied. Factor loadings of 0.4 or higher are considered significant for a sample size of 200. Due to this, ATR_16, ATR_23, ATR_24 and ATR_25 were eliminated because of their weakly loadings.

The first factor was most important because it explained 33.126% of the total variance in the ATR and has the highest eigenvalue of 9.275. Upon inspection of the items that loaded on this factor, it was found that all of the items describe the usefulness of Research to the daily lives or even at work. These are ATR_2, ATR_8, ATR_14, ATR_15, ATR_17, ATR_20, ATR_21 and ATR_22.

Hence this factor was called the **Usefulness of Research**. The internal consistency of the items was also assessed by Cronbach's alpha which was 0.912 implying a high level of reliability.

The second factor explained 13.81% of the total variance in the ATR and has an eigenvalue of 3.87. Upon inspection of the items that loaded on this factor, it was found that all of the items (ATR_3, ATR_4, ATR_5, ATR_12 and ATR_13) describe likeness and interest in Research. Hence this factor was called **Positive Attitudes**. The internal consistency of the items was also assessed by Cronbach's alpha which was 0.908 implying a high level of reliability.

The items in the third factor express the idea of negative feelings about Research; hence this factor is called the **Negative Attitudes** factor. Items ATR_1, ATR_7, ATR_6, ATR_26, ATR_28 and ATR_32 loaded heavily on this factor. This factor also explained 7.52 % of the total variance in the ATR and has the eigenvalue of 2.1. The internal consistency of the items was also assessed by Cronbach's alpha which was 0.791 implying a appropriate level of reliability.

The fourth factor is called **Relevance of Research**. This is because the items ATR_19, ATR_27, ATR_29, ATR_30 and ATR_31 applied to applicability of Research to life and work. This factor explained 5.55% of the total variance in the ATR and has the eigenvalue of 1.554. The internal consistency of the items was also assessed by Cronbach's alpha which was 0.844 implying a high level of reliability.

The fifth factor explained 4.56 % of the total variance in the ATR and has the eigenvalue of 1.28. Upon inspection of the items that loaded on this factor, it was found that all of the items describe mistakes, nervousness and numerical difficulty in Research. These are ATR_9, ATR_10, ATR_11 and ATR_18. Hence this factor was called the **Difficulty Attitude**. The internal consistency of the items was also assessed by Cronbach's alpha which was 0.815 implying that the scale is reliable.

Factor Analysis of Evaluation of Teachers by Students (ETS)

For the variable Evaluation of Teachers by Students (ETS), the suitability of the data for factor analysis was determined by utilizing the Kaiser-Meyer-Olkin (KMO) and the Bartlett's test. With the factor analysis conducted on the data obtained from the scale, the KMO measure was found to be 0.95, which is more than adequate. Barlett's coefficient, with its associated probability of less than 0.001 was identified to be significant.

The results of the KMO and Bartlett's tests indicated that a factor analysis could be performed on the data. Next, the factor analysis using the orthogonal VARIMAX method of rotation was run. However, data cannot be rotated since the scale was found to be uni-dimensional, implying that all twelve items are loaded to one construct.

This sole dimension explained 58.7 percent of the total variance. As reported in Table 5, Cronbach's alpha values of the ETS scale of one factor or dimension is $\alpha = 0.944$. As Hair, et. al. (2006) suggested reliability must be 0.6 or higher, for one to accept a scale. This measure of internal consistency assesses how reliable multiple items are in measuring the same characteristic. Hence, the ETS is considered highly-reliable.

Table 5: Factor Analysis Results for ETS Data

Items		Factor
ETS_1	Explain the reasons for doing research.	0.565
ETS_2	Explain the different components	0.791
ETS_3	Discuss our research format	0.692
ETS_4	Conceptualize our research proposal	0.825
ETS_5	Ensure the connectedness of the different components of the research format	0.796
ETS_6	Meet the schedule defense	0.765
ETS_7	Address research flaws and errors	0.749
ETS_8	Observe and use our resources properly	0.764
ETS_9	Enables us to work together as a team	0.700
ETS_10	Enables us to express our research needs and identify possible solution	0.811
ETS_11	Carefully observe and follow the research policies	0.836
ETS_12	Value our efforts and findings	0.854
	Eigenvalue	7.045
	% Variance	58.707
	Reliability by Cronbach's α	0.944
	KMO = 0.947	
	Bartlett's Test of Sphericity Chisquare = 1812.684, df = 66, p < 0.001	

Structural Equation Modeling (SEM) to establish causal relationship between ATR and ETS

Model A

The hypothesized model describes a five-factor structure of the Attitudes towards Research (ATR) and a three-factor ETS. This model is labeled Model A for the possibility of model development based on modification. The factors or dimensions of ATR are the exogenous variables and the factors of ETS namely knowledge, skills and attitudes are the endogenous variables. This model was specified because of Papanastasiou's (2005) proposed factor structure with five dimensions namely; Usefulness of Research, Positive Attitudes, Negative Attitudes, Relevance of Research and Difficulty of Research.

The ETS, on the other hand, was hypothesized to have three dimensions because this is what the University of Mindanao's proposed in the modification of the instrument for determining teacher performance for Research courses. It is also worth noting that there are no assumed relationships among the factors of ATR and ETS. The standardized parameter estimates of this model as well as the fit indices are presented in Table 6.

Table 6: Parameter Estimates of Model A

| Endogenous Variable		Exogenous Variable	Estimate	Standard Error	Critical Ratio	P-value
Knowledge	←	Usefulness	0.492	0.046	7.774	< 0.001
Skills	←	Usefulness	0.384	0.045	6.659	< 0.001
Attitudes	←	Usefulness	0.385	0.048	6.440	< 0.001
Knowledge	←	Positive Attitude	-0.002	0.035	0-.028	.977
Knowledge	←	Negative Attitudes	0.208	0.044	3.449	< 0.001
Knowledge	←	Relevance	0.175	0.049	3.022	.003
Knowledge	←	Difficulty	0.749	0.132	6.795	< 0.001
Skills	←	Positive Attitude	0.004	0.037	0.078	.938
Attitudes	←	Positive Attitude	0.013	0.039	0.227	.821
Skills	←	Negative Attitude	0.315	0.048	5.165	< 0.001
Attitudes	←	Negative Attitude	0.330	0.051	5.195	< 0.001
Skills	←	Relevance	0.209	0.051	3.666	< 0.001
Attitudes	←	Relevance	0.150	0.054	2.576	.010
Skills	←	Difficulty	0.876	0.156	7.192	< 0.001
Attitudes	←	Difficulty	0.763	0.144	6.953	< 0.001
CMIN/df = 3.216, CFI = 0.722, TLI = 0.701, GFI = 0.65, RMSEA = 0.130						
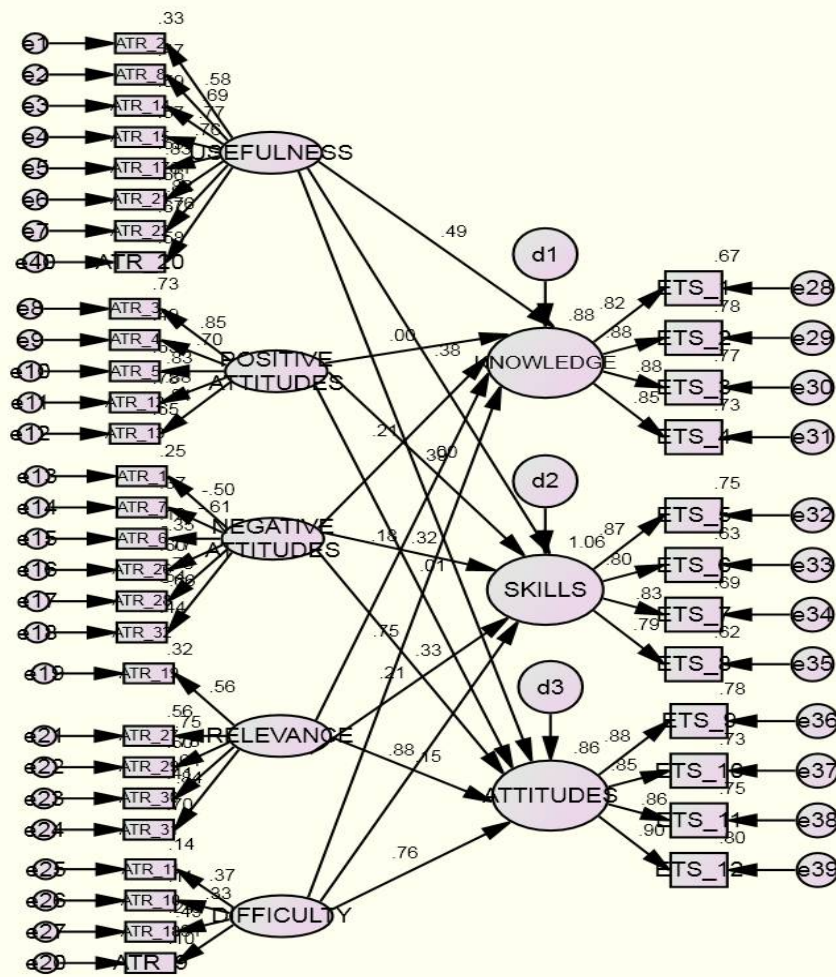
Figure 3. Structural Model A

It was found that the first factor, which is Usefulness significantly predict knowledge, skills and attitudes of Evaluation of Teachers. That is when students realize the Usefulness of Research as a course in college; they tend to increase their ratings of their teachers in the items under knowledge, skills and attitudes of the ETS. Likewise, the fifth factor or Difficulty of Research also significantly determines how they rate the teachers' knowledge, skills and attitude of the subject. Considering again the indicators of Difficulty, they refer to the complicatedness of the statistics and mathematics involved in Research.

To describe this model's fit, CMIN/df = 3.216 exceeds the prescribed value of 3, CFI = 0.722 is less than prescribed value of at least 0.9, TLI = 0.701 is less than prescribed value of at least 0.95, GFI = 0.65 is less than prescribed value of at least 0.9 and RMSEA = 0.103 is greater than prescribed value of at most 0.06. Hence Model A does not possess good fit over the empirical data. Figure 3 provides a graphical view of Model A.

Model B

The first proposed model (Model B) describes a five-factor structure of the Attitudes towards Research (ATR) and a one-factor ETS. This model was arrived because model A failed to exhibit appropriate fit to the data. Upon exploring on the ETS data, it was found that ETS is one-dimensional and not three-dimensional as proposed in model A. The factors or dimensions of ATR namely Usefulness, Positive Attitudes, Negative Attitudes, Relevance and Difficulty are the exogenous variables and the single latent construct Evaluation of Teachers by Students as

endogenous. In this model, it is also assumed that there are no interrelationships among the factors of ATR. Standardized parameter estimates of this model as well as the fit indices are presented in the Table 7.

Table 7. Parameter Estimates of Model B

Endogenous Variable	Exogenous Variable		Estimate	Standard Error	Critical Ratio	P-value
Evaluation of Teachers by Students	←	Usefulness	0.414	0.044	5.693	< 0.001
Evaluation of Teachers by Students	←	Positive Attitudes	-0.023	0.034	-0.359	0.720
Evaluation of Teachers by Students	←	Negative Attitudes	0.048	0.040	0.706	0.480
Evaluation of Teachers by Students	←	Relevance	0.183	0.048	2.664	0.008
Evaluation of Teachers by Students	←	Difficulty	0.294	0.054	3.734	< 0.001

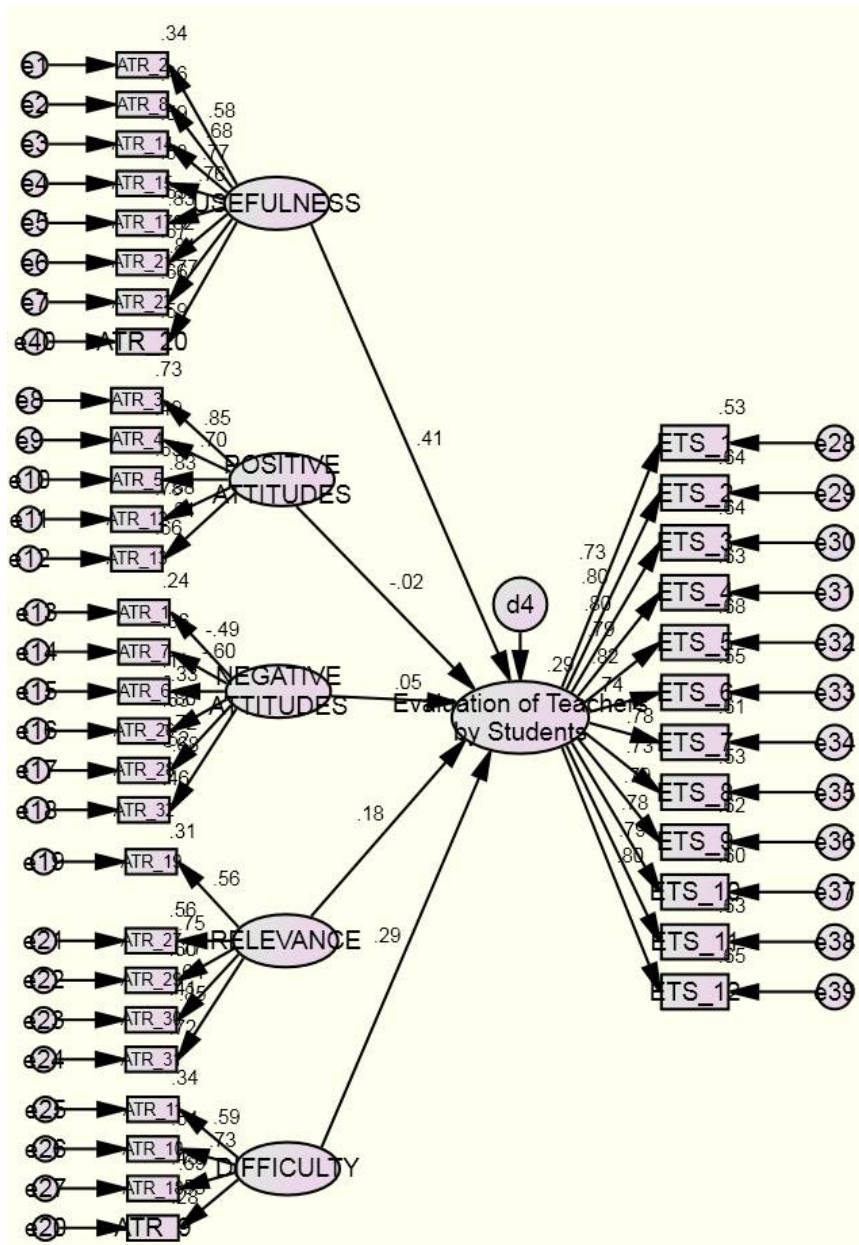CMIN/df = 3.19, CFI = 0.72, TLI = 0.708, GFI = 0.648, RMSEA = 0.103

Figure 4. Structural Model B

It is gleaned that among the factors of ATR, Usefulness and Difficulty significantly determine Evaluation of Teachers by Students. This result is similar to the first model. So looking into the fit indices, CMIN/df = 3.19 exceeds the prescribed value of 3, CFI = 0.72 is less than prescribed value of at least 0.9, TLI = 0.703 is less than prescribed value of at least 0.95, GFI = 0.648 is less than prescribed value of at least 0.9 and RMSEA = 0.103 is greater than prescribed value of at most 0.06. Hence Model B still does not possess good fit over the empirical data. Figure 4 presents the graphical view of the structural model B and its parameter estimates.

Model C

Due to inability of Model B to exhibit good fit to the data, modification of the model was performed and Model C was proposed. Model C still considers that ATR has five factors and Evaluation of Teachers by Students is one-dimensional. However, the result of Elena Papanastasiou's factor analysis of the ATR, specifically on the covariances among the latent factors of ATR is now integrated in Model C. Re-specification was done by adding paths between the factors of ATR namely Usefulness covary with Positive Attitudes, Negative Attitudes, Relevance and Difficulty; Positive Attitudes covary with Negative Attitudes, Relevance and Difficulty; Negative Attitudes covary with Relevance and Difficulty and Relevance covary with Difficulty. Parameter estimates of this model are shown in Table 8.

Table 8. Parameter Estimates of Model C

Endogenous Variable	Exogenous Variable	Estimate	Standard Estimates	Critical Ratio	P-value
Evaluation of Teachers by Students	← Usefulness	0.502	0.077	3.847	< 0.001
Evaluation of Teachers by Students	← Positive Attitudes	-0.070	0.051	-0.718	0.473
Evaluation of Teachers by Students	← Negative Attitudes	0.190	0.082	1.435	0.151
Evaluation of Teachers by Students	← Relevance	0.168	0.087	1.327	0.184
Evaluation of Teachers by Students	← Difficulty	0.455	0.085	3.116	0.002

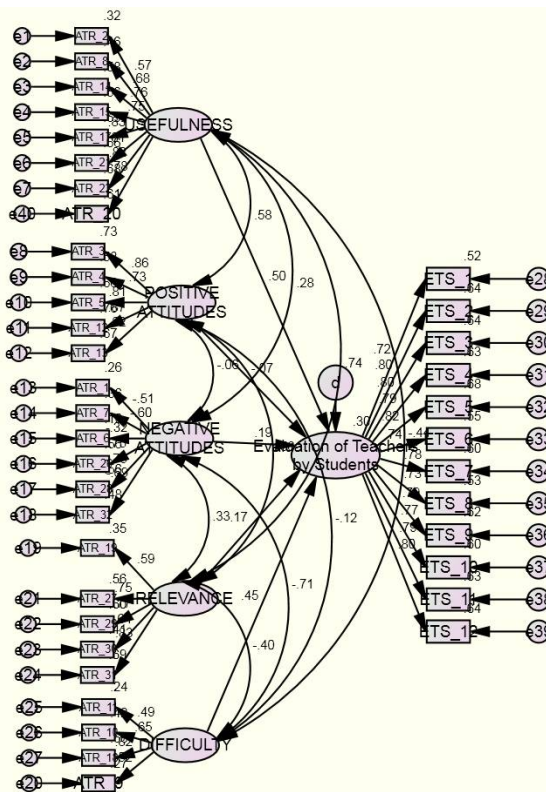CMIN/df = 2.807, CFI = 0.77, TLI = 0.756, GFI = 0.62, RMSEA = 0.093

Figure 5. Structural Model C

Table 8 shows that only Usefulness and Difficulty under ATR significantly determine Evaluation of Teachers by Students. This has been the finding also in Model A and Model B. However, now that model C assumes covariances among the factors or dimensions of ATR, the change in model fit indices are analyzed. CMIN/df = 2.807 now meets the prescribed value of less than 3, CFI = 0.77 is less than prescribed value of at least 0.9, TLI = 0.756 is less than prescribed value of at least 0.95, GFI = 0.62 is less than prescribed value of at least 0.9 and RMSEA = 0.093 is still greater than prescribed value of at most 0.06. Model C has only satisfied the CMIN/DF criterion. But it is also worth noting the CFI, TLI and GFI values have moved closer to the standard value. This indicates that Model C is better than Models A and B.

The result also implies that the different dimensions of students' attitudes towards research are interrelated. (See Table 9) This conforms to the results of Papanastasiou (2005). Hence, students' attitude on the Usefulness of research can also affect their negative attitudes, positive attitudes, relevance, and difficulty. A student's positive attitudes towards research related to his/her relevance and difficulty. Likewise, a student's negative attitudes can be related to relevance and difficulty. Finally, a student's attitude towards the relevance of research can be connected to his attitude on the difficulty of research. Refer to Figure 6 for the pictorial view of the model and its parameters.

Table 9. Covariances among the Factors of ATR

Factors of ATR		Estimate	Standard Error.	Critical Ratio	P-value
Usefulness	←→ Negative Attitudes	0.368	0.113	3.246	.001*
Usefulness	←→ Positive Attitudes	0.898	0.143	6.300	< 0.001
Positive Attitudes	←→ Negative Attitudes	-0.089	0.120	-0.744	.457
Usefulness	←→ Relevance	0.885	0.128	6.906	< 0.001
Usefulness	←→ Difficulty	-0.624	0.130	-4.788	< 0.001
Negative Attitudes	←→ Relevance	0.378	0.103	3.659	< 0.001
Negative Attitudes	←→ Difficulty	-0.960	0.153	-6.264	< 0.001
Positive Attitudes	←→ Relevance	0.743	0.126	5.889	< 0.001
Positive Attitudes	←→ Difficulty	-0.193	0.132	-1.460	0.144
Relevance	←→ Difficulty	-0.486	0.114	-4.255	< 0.001

Model D

This model was developed based on the results of the analysis of Model C. Model D represents a two-factor structure of the Attitudes towards Research (ATR) and a one-dimensional ETS. The factors or dimensions of ATR are the exogenous variables, namely Usefulness and Difficulty and ETS as endogenous. This model was obtained due to the fact that in the previous model (Model C), only these two exogenous variables significantly predict ETS. They were also found to be significantly related. Standardized parameter estimates of this model as well as the fit indices are presented in the Table 10.

Table 10. Parameter Estimates of Model D

Endogenous Variable	Exogenous		Estimate	Standard Error	Critical Ratio	P-value
Evaluation of Teachers by Students	←	Usefulness	0.564	0.056	6.25	< 0.001
Evaluation of Teachers by Students	←	Difficulty	0.289	0.06	3.21	0.001
CMIN/df = 2.55, CFI = 0.89 , TLI = 0.86, GFI = 0.78, RMSEA = 0.08						

It was found that how students evaluate their Research Teachers are determined by the students' attitudes on the Usefulness of research and the Difficulty of research. However, between these two, it is the Usefulness of research that has more influence on ETS. These two attitudes are also significantly related with a covariance estimate of 0.599.

As to this model's fit, CMIN/df = 2.55 now meets the prescribed value of less than 3, CFI = 0.89 is close to the prescribed value of 0.9, TLI = 0.86 also approaches prescribed value of at least 0.95, GFI = 0.78 is less than prescribed value of at least 0.9 and RMSEA = 0.08 is still greater than prescribed value of at most 0.06. It can be observed also that all these fit indices moved towards the criterion as compared to the three previous models. Figure 6 presents the pictorial view of Model D.
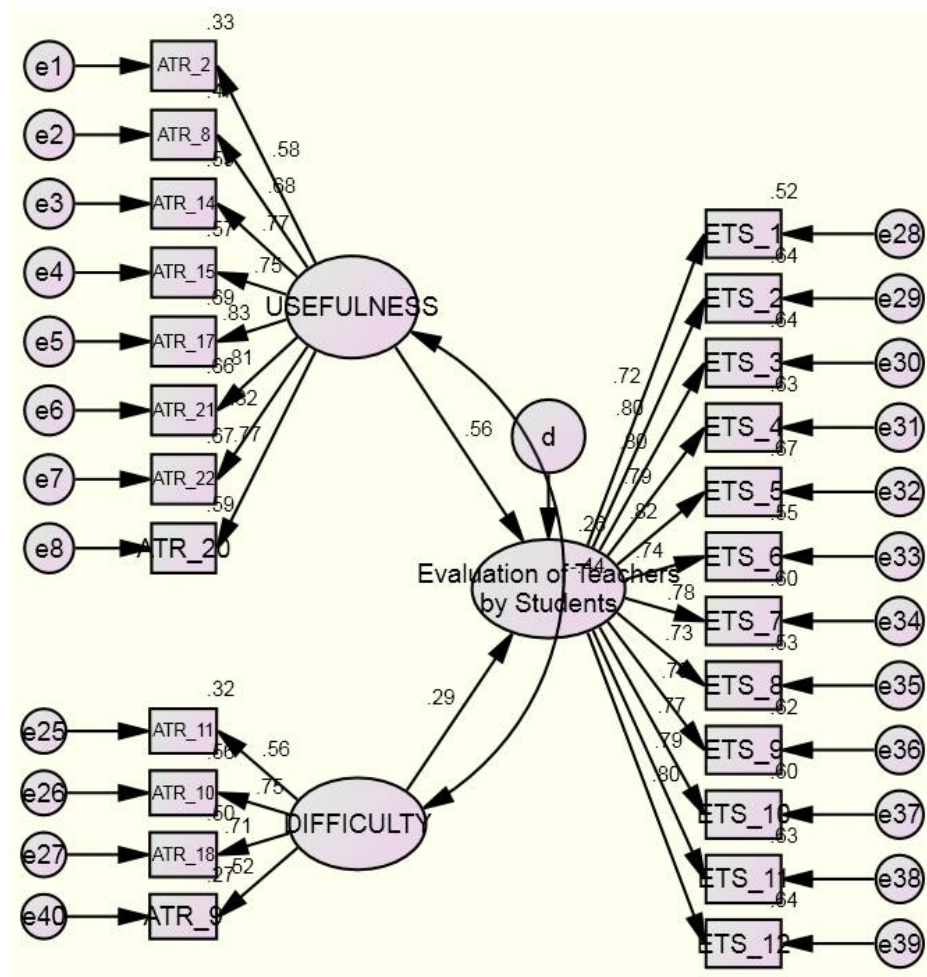

Figure 6. Structural Model D

A summary of the fit indices of the four structural models considered in this study is found in Table 11. This table reveals that using the standard values determined earlier in this study, Model A and Model B have not reached the criteria. Thus it is concluded that these models do not fit the empirical data in this study. However, an improvement can be found in model C because the CMIN/DF value is now less than 3. In model D, the CMIN/DF is lesser hence this model has better fit. Moreover, Model D also has TLI, GFI and CFI values closer to the prescribed values. Thus, it is concluded that the final model to describe ATR and ETS is model D.

Table 11. Comparison of Model Fit

Model	Fit Indices				
	CMIN/DF	TLI	GFI	CFI	RMSEA
A	3.216	0.701	0.65	0.722	0.103
B	3.19	0.78	0.65	0.72	0.103
C	2.801	0.756	0.62	0.77	0.093
D	2.55	0.89	0.78	0.89	0.08

CONCLUSION

Students' Attitudes towards Research (ATR) is multidimensional. Its factor structure revealed five factors, namely Usefulness of Research, Positive Attitudes, Negative Attitudes, Relevance of Research and Difficulty of Research. This confirmed Papanastasiou's (2005) ATR scale. The factors were considered latent and formed the measurement models in SEM.

The Evaluation of Teachers by Students (ETS), which is a measure of teachers who handled Research courses in UM Digos College was hypothesized to have three constructs. However, this study revealed that it is one-dimensional. This single construct was also latent and the 12 indicators significantly loaded on it. With appropriate measures like Cronbach's alpha, the ETS is a highly reliable scale.

On the investigation of the causal relationship of ATR and ETS, structural equation modeling (SEM) was used because of its ability to analyze latent constructs. The hypothesized model with a five-factor ATR and a three-factor ETS did not satisfy the fit indices used in this study. Thus using theoretical basis, parameter estimates and fit indices, three models were developed. Among these, the model that best fit the empirical data of this study was a two-factor ATR and a one-dimensional ETS. This model suggests that students' evaluation of their Research teacher is highly determined by their attitudes towards the Usefulness of Research and Difficulty of Research.

REFERENCES

Akgül, A. (2005). *Tıbbi araştırmalarda istatistiksel analiz teknikleri: SPSS uygulamaları.* Yükseköğretim kurulu matbaası.

Bentler, P. M. & Bonett, D. (1980). Significance Tests and Goodness of Fit in the Analysis of Covariance Structures. Vol. 88, No. 3, 5SS-606

Brew, A. (2001). *The nature of research: Inquiry in academic contexts.* Psychology Press.

Demirel, Ö. (2003). *Eğitim sözlüğü.* PeGem A Yayıncılık.

Given, L. M. (Ed.). (2008). *The Sage encyclopedia of qualitative research methods.* Sage Publications.

Hofman, F. E. & Kremer, L. (1980). *Attitudes toward higher education and course evaluation, Journal of Educational Psychology.*

Hu, L. & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Structural Equation Modeling: A Multidisciplinary Journal, 6 (1), pp. 1-55.

Kagitcibasi C. (1999). *New Human and People,* (10th Edition). Istanbul: EvrimBasim-Yayim_DAgitim

Karasar, N. (2000). Scientific method of research. *Ankara: Nobel Publishing.*

Kenny, D. A. (2014). SEM: Fit. Retrieved last March 4, 2014 at http://davidakenney.net/cm/fit.htm.

Kline, P. (1999). The handbook of psychological testing (2nd Ed.). London: Routledge.

Kline, R. B. (2011). *Principles and practice of structural equation modeling.* Guilford press.

MacCallum, M., Browne, R. & Sugawara, L. (1996). Factor analysis class notes. Available from M. Browne, 228 Lazenby Hall, 1827 Neil Avenue, Columbus, OH 43210.

Marczyk, G., DeMatteo, D., & Festinger, D. (2005). *Essentials of research design and methodology*. John Wiley & Sons Inc.

Papanastasiou, E. C. (2005). Factor structure of the" Attitudes toward Research" Scale. *Statistics Education Research Journal, 4*(1), 16-26.

Papanastasiou, E. C., & Zembylas, M. (2008). Anxiety in undergraduate research methods courses: its nature and implications. *International Journal of Research & Method in Education, 31*(2), 155-167.

Wright, W. A. & O'Neil, M C. (1992). Improving summative student ratings of instruction practice. *Journal of Staff, Program, and Organizational Development Introduction to SEM.* (Webinar Slides).pdf

Wuensch, K. L. (2007). Independent variables and dependent variables. Retrieved last March 17, 2014 from http://core.ecu.edu/psyc/wuenschk/StatHelp/IV-DV.htm