Focus **ACT**ion **O**f **R**esearch **M**athematic
Volume 6, No. 02, July - December, 2023
Page 25 - 40

ISSN: 2655-3511 (print)
ISSN: 2656-307X (online)
DOI:10.30762/f_m.v6i2.1987

Structural Equation Modeling (SEM) on Mechanisms of Non-Science Students' Attitudes Toward Statistics Courses

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Keywords

Distress, Academic Help-Seeking, The Attitudes of Non-Science Students in Statictics, Structural Equation Modeling. Mediator, SmartPLS.

ABSTRACT

Penelitian ini bertujuan untuk mengkaji hubungan langsung dan tidak langsung antara distress dan sikap mahasiswa non-sains terhadap mata kuliah statistika, dengan academic help seeking sebagai mediator. Menggunakan metode kuantitatif dengan survey design, penelitian ini melibatkan mahasiswa Prodi Psikologi Islam di IAIN Kediri yang mengambil mata kuliah Statistika. Data dikumpulkan melalui instrumen skala dengan penskalaan Likert summated rating. Analisis data dilakukan menggunakan Structural Equation Modeling dengan bantuan software SmartPLS. Hasil output SmartPLS menunjukkan bahwa distress memiliki hubungan negatif terhadap sikap mahasiswa non-sains dalam mata kuliah statistika. Hal ini disebabkan oleh peran academic help-seeking yang diidentifikasi sebagai bentuk self-regulation, yaitu mekanisme adaptif yang digunakan oleh subyek penelitian dalam menghadapi distress saat belajar statistika. Tingginya tingkat academic help-seeking sebagai mediator menciptakan mekanisme yang membentuk sikap positif terhadap mata kuliah statistika.

Distress, Academic Help-Seeking, The Attitudes of Non-Science Students in Statictics, Structural Equation Modeling. Mediator, SmartPLS.

This study aims to explore the direct and indirect connections between distress and the attitudes of non-science students towards statistics, considering academic help-seeking as a mediator. Employing a quantitative approach with a survey design, the study sampled students from the Islamic Psychology Program at IAIN Kediri who are currently enrolled in a Statistics course. Data was gathered through scale instrumentation and a Likert-type summated rating scale. Structural Equation Modeling, supported by SmartPLS software, was used for data analysis. The findings from SmartPLS reveal that distress negatively impacts non-science students' attitudes toward statistics. This effect occurs because academic help-seeking functions as a form of self-regulation or adaptive strategy, as displayed by students experiencing distress in statistics. High levels of academic help-seeking serve as a mediator, facilitating the development of a positive attitude toward statistics courses.

INTRODUCTION

Statistics is a method used to answer problems, especially in the field of social sciences and humanities. This makes statistics a core subject at the higher education level in Indonesia. Statistics is a compulsory subject in psychology faculties or study programs as part of the social sciences and humanities, teaching basic concepts and statistical techniques that can be applied in the world of research and industry.

Lecture materials include quantitative data presentation, data description, probability, random and discrete variables, and sampling distribution.

The results of the study in the odd academic year 2022/2023 in the psychology study program of IAIN Kediri, out of 219 students, only 15% of students received an A (Study Result Card, 2022). Difficulties in understanding statistics courses are not only related to non-cognitive factors such as attitudes, perceptions, expectations and motivation, but also influenced by students' cognitive factors such as intellectual capabilities towards statistics courses. Both factors can be an obstacle in the process of learning statistics and improving the ability to do assignments.

Based on previous research, students are stated to tend to have barriers in terms of non-cognitive factors such as anxiety can affect the reasoning process and attitudes towards statistics courses (Saidi, S.S & Siew, N. M., 2022); Students realize the importance of the value of learning statistics, especially in Medical Science students, but their attitudes tend to be negative towards statistics courses (Althubaiti, 2021); Doctoral students still need a review of undergraduate statistics and often experience anxiety and negative attitudes when taking statistics courses (Cook & Catanzaro, 2023). From these studies, it is still limited regarding how the

mechanism models the attitude of non-science students, especially towards statistics courses. In this study, it will try to reveal non-cognitive factors in explaining student attitudes towards statistics courses. Distress can be related to attitudes towards statistics courses that are mediated by academic help-seeking.

Psychological distress is emotional suffering characterized by somatic symptoms (Perrewé and Carlson, 2002). On the other hand, Mental distress refers to non-specific symptoms of stress, anxiety and depression. High levels of psychological distress are an indicator of mental health and may reflect certain mental disorders such as depressive and anxiety disorders (Cuijpers et. al., 2009). Distress is negative stress followed by symptoms such as: anxiety over something, duration can be short or long, feeling uncomfortable, decreased performance, can have an impact on physical and mental disorders (Silva, Vitti, and Faro, 2021). Distress can trigger mental insecurity. High levels of distress in students studying statistics courses can hinder the learning process and hinder learning achievement (Le, Hassan & Saharuddin, 2023).

Academic seeking-help is a process of interaction between students and others to get solutions to the difficulties experienced by Runco et.al., (2014). Help-seeking can prevent possible mistakes and increase learning independence to improve learning achievement or achievement. Academic help-seeking is a form of behavior related to self-regulation when experiencing difficulties. Academic help-seeking can have a positive impact on students' ability to control challenges and can increase academic success (Eisenberg, Golberstein & Gollust, 2007). Students' academic landscape can be more competitive, so it can encourage students to seek and use academic support to recognize and develop learning experiences and learning achievements (Le, Hassan & Saharuddin, 2023).

Researchers have defined attitudes in various terms. Attitude research is important to uncover feedback on a phenomenon. Attitude consists of five components: emotion, purpose, direction, strength, and consistency, each encompassing positive, neutral, and negative aspects. Psychologically, attitude is considered a mental state inherent in a person, shaped by experience, which influences their reactions to objects or related phenomena (Ashaari et al., 2011). Attitudes are processed through a continuous process of learning and practice (Schau, 2003).

In this study, attitudes will be explored based on the affective component, which means assessing students' attitudes towards statistics courses in terms of affective experiences (Male & Lombantoruan, 2021). Affective experiences are related to emotions and feelings of like or dislike experienced by subjects towards statistics courses. Furthermore, the cognitive component of attitude in the form of students' cognitive abilities towards statistics courses is also a consideration in revealing students' experiences of statistics courses (Ashaari et., al., 2011). With regard to student attitudes towards knowledge and intellectual abilities such as, the ability to understand statistical concepts, the ability to calculate, and understand the formulas used in learning statistics courses. In the context of attitude diterminan related to whether or not students' evaluation of statistics courses is academic seeking-help as adaptive self-regulation as a learning strategy that can facilitate the creation of positive academic results (Thomas & Tagler, 2019).

Based on the literature review above, the following hypotheses can be formulated:

First hypothesis

H_{01} : Distress is not related to non-science students' attitude towards statistics courses.

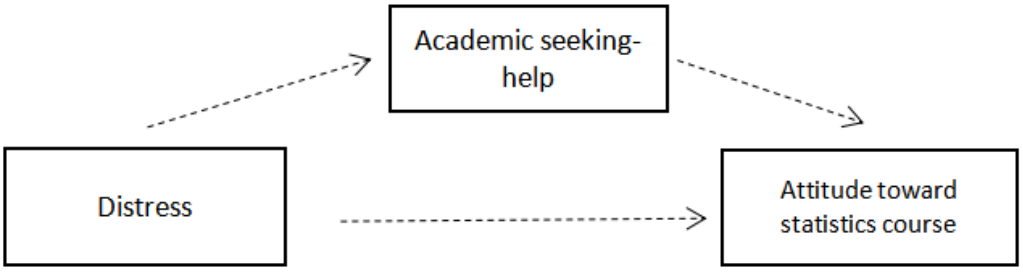
H_{a1} : Distress is related to non-science students' attitude towards statistics courses.

Second hypothesis

H_{02}: The relationship between Distress and non-science students' attitude towards statistics courses cannot be mediated by academic seeking-help.

H_{a2}: The relationship between distress and non-science students' attitude towards statistics courses can be mediated by academic seeking-help.

Figure 1 Framework of Attitude toward Statistics Course



METHODS

This research uses a quantitative approach, which is an approach to test theories objectively by testing the relationship between research variables (Creswell, 2014). The variables studied can be measured by instruments, so the data will be in the form of numbers that can be analyzed using certain statistical procedures. The statistical procedure used in this study is inferential statistics. Inferential statistical procedures are used to make scientific predictions about the population based on random samples from the population (Glenberg & Andrzejewkski, 2008).

Survey-based research design is used in answering questions or hypotheses in this study. Survey research design is a procedure in quantitative research that is applied by researchers by conducting a survey action process on subjects, populations, and or research samples as a whole to describe their attitudes, opinions, behaviors or characteristics (Glenberg & Andrzejewkski, 2008).

This research explores several variables that will be connected to each other in a research model framework. Distress is identified as the independent variable (X); it is called a covariate because the change in value is closely related to the dependent variable and the change is not due to another independent variable, rather there is a minimal relationship with another independent variable or covariate (MacKinnon, 2008). The relationship between the independent variable and the dependent variable is mediated by the mediator variable. Attitude towards statistics courses acts as the dependent variable (Y). In this study, there is one mediator variable that mediates between distress and attitude towards statistics courses, namely academic help-seeking as a mediator.

Research subjects are individuals involved in a study to obtain information on the responses given through the media instrument in the form of a scale that has been prepared based on research variables Myers & Hansen, 2011). The population was 237 students of Psychology Study Program IAIN Kediri who are taking statistics course in odd academic year 2023/2014. The criteria for subjects in this study are as follows: a) Students of Psychology IAIN Kediri; b) Currently taking statistics courses.

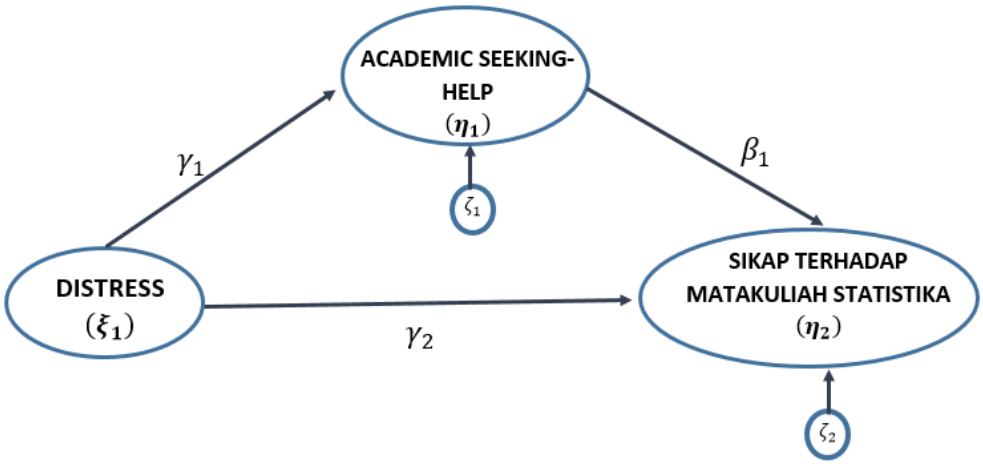
Sampling technique is the process of collecting data from subjects (Myers & Hansen, 2011). The method of taking research subjects using incidental sampling

techniques, namely sampling techniques based on chance. So, anyone who by chance or incidentally meets the researcher can be used as a research subject if the person encountered matches the characteristics of the research subject used by the researcher (Leary, 2012).

This research data collection technique uses scale instrumentation. The scale is a stimulus in the form of a list of statements given to research respondents and respondents must respond in writing (Furr, 2022). The scaling method is in the form of Likert summated rating, which means conducting a sample test of the behavior indicated in the data collection scale. The attitude scale towards statistics courses consists of eleven items using a Likert scale (1 = very unsuitable, 2 = unsuitable, 3 = suitable, 4 = very suitable). The academic help-seeking scale consists of ten items using a Likert scale (1 = very unsuitable, 2 = unsuitable, 3 = suitable, 4 = very suitable). The Distress scale consists of ten items using a Likert scale (1 = very unsuitable, 2 = unsuitable, 3 = suitable, 4 = very suitable). The interpersonal communication scale consists of nine items using a Likert scale (1 = highly discordant, 2 = discordant, 3 = appropriate, 4 = highly appropriate).

To carry out data analysis in accordance with the aim of proving the model built based on theoretical assumptions and empirical facts appropriately and correctly, researchers will use the Structureal Equation Modeling (SEM) technique (Keith, 2019).

Figure 2 Structure Equation Modeling



Based on Figure 2, the structural model will prove that there is a direct influence between distress and attitudes towards statistics courses. However,

distress will also be proven to have an indirect effect on attitudes towards statistics courses mediated by academic seeking-help.

The path coefficient is the standardized regression coefficient calculated based on the two structural equations in the path to be tested. The two equations are as follows:

$\eta_1 = \gamma_1 \xi_1 + \zeta_1$ ..... (1)

$\eta_2 = \gamma_2 \xi_1 + \beta_1 \eta_1 + \zeta_2$ ..... (2)

Descriptions:

η_1 : $Academic\ Seeking - help$

η_2 : Attitude toward Statistics Course

ξ_1 : Distress

γ_1 :Path coefficient between Distress constructs and Academic Seeking-help

γ_2: Path coefficient between Distress construct and Attitude towards Statistics course

β_1: Path coefficient between academic seeking-help constructs and attitude towards statistics courses

ζ_1 : Measurement error for the academic help seeking construct

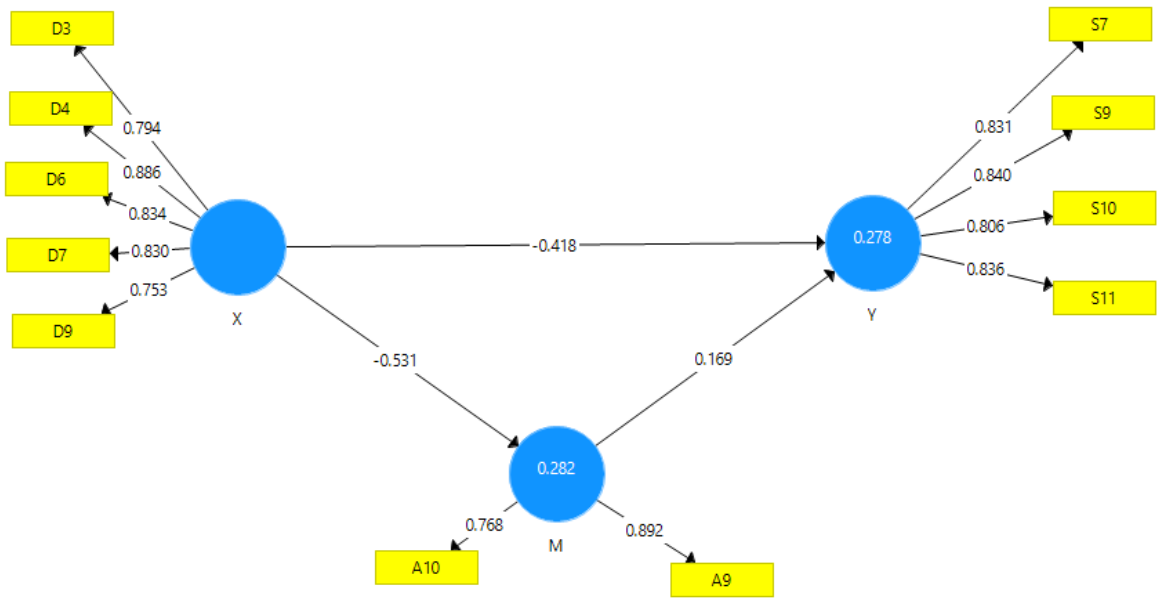
ζ_2 : Measurement error for the construct of attitude toward statistics courses

Index of Fit in Structural Equation Modeling (SEM) is used to determine the suitability between the model a priori built by the researcher and the model inferred from sample data from the empirical domain. Index Fit criteria in structural modeling (SEM) include: RSMEA is another important reference for testing an index fit in structural modeling. RMSEA is used as a basis for knowing how good a model whose parameters are unknown, however, the selected parameters are stated to be able to optimally estimate the fit in the population of the covariance matrix (Keith, 2019). RMSEA values in the range of 0.05 to 0.10 may indicate a fair or moderate fittedness and values above 0.10 may indicate a weak fittedness (Keith, 2019). RMSEA values between 0.08 to 0.10 indicate a good model fit.

RESULT AND DISCUSSION

Of the total population of 237, 202 samples will be used to examine the data. The following are the results of the modeling construct using the SmartPLS application.

Figure 2 PLS Algorithm Output with SmartPLS



There are three stages of testing in SEM, namely:

1. Outer Model Testing

The outer model testing stage is the measurement model testing stage which aims to prove the validity and estimate the reliability of indicators and constructs. The requirements that must be met are (1) Convergent Validity value seen from the outer loading output is more than 0.7, (2) Discriminant Validity value seen from the reflective construct AVE output is more than 0.5. and the square root of AVE is greater than the correlation between constructs, and (4) Composite Reliability value and Cronbach Alpha value are more than 0.7.

a. *Convergent Validity*

Convergent validity is done by looking at the item reliability indicated by the outer loading value from the SmartPLS software outer loading output. The outer loading value is said to fulfill convergent validity if it is more than 0.7.

Table 1 Outer Loadings Output

	M	X	Y
A10	**0,768**		
A9	**0,892**		

D3		**0,794**	
D4		**0,886**	
D6		**0,834**	
D7		**0,830**	
D9		**0,753**	
S10			**0,806**
S11			**0,836**
S7			**0,831**
S9			**0,840**

Based on table 1, it can be seen that all outer loading values are more than 0.7. so it can be concluded that the indicators of each construct have a high level of validity and meet convergent validity.

b *Discriminant Validity*

To see discriminant validity, it is done by comparing the AVE root value with the correlation coefficient between constructs. The condition for a construct to have good discriminant validity is that the AVE root value is greater than the correlation coefficient value. The discriminant validity output is shown in the following table:

Tabel 2 ***Output Discriminant Validity***

	M	X	Y
M	0,833		
X	-0,531	0,820	
Y	0,391	-0,507	0,828

Based on table 2, all constructs show an AVE square root value that is greater than the correlation value, so it can be concluded that the constructs in the research model have good discriminant validity.c *Composite Reliability*

Composite reliability is used to see the reliability of a construct. A construct or latent variable is declared reliable if the composite reliability value is greater than 0.7. SmartPLS output results are shown in the following table :

Tabel 3 ***Composite Reliability***

	Composite Reliability
M	**0,818**
X	**0,911**
Y	**0,897**

Based on table 3, the composite reliability value for all constructs is greater than 0.70. thus it can be concluded that all constructs have good reliability in accordance with the predetermined minimum limit.

The Outer Model testing stage has met the validity and reliability requirements, so it can be concluded that the indicators of each construct are valid and reliable, then it will proceed to the Goodness of Fit Model testing stage.2 Uji *Goodness of Fit Model*

The Goodness of Fit Model testing stage aims to test the predictive power of the model and the feasibility of the model. The model is said to be fit if the SRMR value is less than 0.10.

Table 4 *Output Model Fit*

	Saturated Model	Estimated Model
SRMR	0,083	0,083
d_ULS	0,459	0,459
d_G	0,173	0,173
Chi-Square	205,544	205,544
NFI	0,809	0,809

The output results in table 4 show that the SRMR value is 0.083 which is less than 0.10. This shows that the model is fit or feasible to use.

3 *Inner Model Test*

Inner Model Test is used to test or see the significance of the influence of exogenous variables on endogenous variables.

a Determination test R^2

The coefficient of determination R^2 is used to determine the influence of exogenous variables on endogenous variables. The coefficient of determination can be seen in the following output

Table 5 *Output R-Square*

	R Square	R Square Adjusted
M	0,282	0,279
Y	0,278	0,271

Based on the R-Square output value in table 5, it shows that the exogenous variable or variable X, namely Distress, is able to explain the Academic Help Seeking variable by 27.9%, while the remaining 72.1% is explained by other variables or constructs. The Distress variable is also able to explain variable Y (Attitude Toward Statistics) by 27.8% and the rest is explained by other constructs outside the constructs studied.

b Hypothesis Test

To see whether a hypothesis that has been prepared can be accepted or rejected through the results of testing the inner model by paying attention to the significance value between constructs, t-statistics, and p-values through bootstraping output. If the t-statistics value> 1.96 and p-values <0.05 (5%) then exogenous significantly affects endogenous. The results of the research model through the bootstraping output can be shown in the following output

Figure 3 Research Model Results

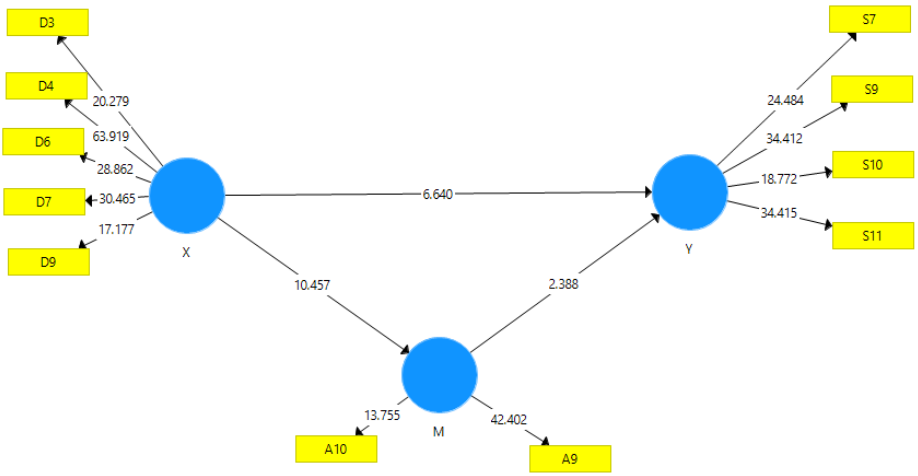


Table 6 Output Path Coefficients

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
M -> Y	0.169	0.166	0.071	2.388	0.017

X -> M	0.531	0.532	0.051	10.457	0.000
X -> Y	-0.418	-0.424	0.063	6.640	0.000

Based on the output of Figure 1 and Table 6, the following results are obtained :

1) Variable X (Distress) is positively related to variable M (Academic Help Seeking). this is evidenced by the Original Sample value of 0.531 and t-statistics of 10.457 which is greater than 1.96 and p-value (0.000) less than 0.05.

2) Variable M (Academic Help Seeking) is positively related to Variable Y (Attitude towards Statistics). Proven through the output of the original sample value of 0.169 and the t-statistics value (2.388) which is greater than 1.96 and the p-value of 0.017 which is less than 5% (0.05).

3) Variable X (Distress) has a negative relationship with Y (Attitude towards statistics). This is evidenced by the original sample value output of -0.418 and the t-statistic value of 6.640 which is greater than 1.96 and the p-value (0.000) which is less than 5% (0.05).

Table 7 *Output Specific Indirect Effect*

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
X -> M -> Y	0.090	0.089	0.040	2.253	0.025

Table 7 provides the results that variable M, namely academic help seeking, is proven to be a significant mediator between variable X, namely distress, and variable Y, namely attitude towards statistics, and all three are also proven to have a positive relationship. This is evidenced by the original sample value which is positive and the t-statistics value of 2.253 is greater than 1.96 and the p-value of 0.025 <0.05. This is evidenced by the positive original sample value and t-statistics value of 2.253 greater than 1.96 and a p-value of 0.025 <0.05.

Based on the results of data analysis, it can be concluded that the two hypotheses proposed at the beginning are proven to accept Ha1 and Ha2. The

negative relationship between distress and attitude toward the course is observed, as academic help-seeking is identified as a self-regulation or adaptive mechanism. When distress is experienced by research subjects while studying statistics courses, high levels of academic help-seeking are utilized as a mediator, enabling a mechanism through which a positive attitude toward statistics courses is developed.

CONCLUSION

Based on the results of the study, it is known that the level of distress of students taking statistics courses is high, when experiencing distress they tend to carry out self-regulation to relieve distress. Academic help-seeking is known as a self-regulation mechanism, this encourages the creation of a positive attitude towards statistics courses, so that learning statistics becomes a pleasant process that is far from tension. Non-cognitive factors are stated to play a dominant role in the learning process of students for achieving good performance in statistics courses, especially those taught in the scope of social sciences or non-science.

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