INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES
HRMARS MANAGEMENT ACADEMIC RESEARCH SOCIETY EXPLORING INTELLECTUAL CAPITAL
www.hrmars.com
ISSN: 2222-6990

Developing and Validating Instruments for Measurement of Motivation, Learning Styles and Learning Disciplines for Academic Achievement

Zamri Chik, Abdul Hakim Abdullah

To Link this Article: http://dx.doi.org/10.6007/IJARBSS/v8-i4/4035 DOI:10.6007/IJARBSS/v8-i4/4035

Received: *06 March 2018,* ***Revised:*** *10 April 2018,* ***Accepted:*** *14 April 2018*

Published Online: 26 April 2018

In-Text Citation: (Chik & Abdullah, 2018)

To Cite this Article: Chik, Z., & Abdullah, A. H. (2018). Developing and Validating Instruments for Measurement of Motivation, Learning Styles and Learning Disciplines for Academic Achievement. *International Journal of Academic Research in Business and Social Sciences*, *8*(4), 585–596.

Vol. 8, No. 4, April 2018, Pg. 585 - 596

http://hrmars.com/index.php/pages/detail/IJARBSS | **JOURNAL HOMEPAGE**

Developing and Validating Instruments for Measurement of Motivation, Learning Styles and Learning Disciplines for Academic Achievement

Zamri Chik, Abdul Hakim Abdullah
Faculty of Islamic Contemporary Studies, Universiti Sultan Zainal Abidin, Gong Badak Campus, 21300 Kuala Terengganu, Terengganu, Malaysia

Abstract
In the study of education, there are still many researchers who use quantitative research methods based on Structural Equation Modeling (SEM) to analyze the various relationships between variables in the model formed based on the theory under study. Before data were analyzed with SEM, Exploratory Factor Analysis (EFA) was needed to identify the appropriate items for use in the research instrument. Therefore, this study was undertaken to develop and validate EFA-based process instruments for the measurement of motivational constructs, learning styles and disciplines of learning about academic achievement for additional mathematics subjects. This study has adapted the instruments that have been developed by some previous researchers based on the School Learning Inventory model developed by Selmes (1987), and modified some statements in accordance with current research. According to Awang (2010; 2012), if a researcher adapts the instrument previously developed by the researcher and modifies the statement to fit the current research, they need to re-run the EFA procedure, as the current field of study may be different from previous research or current research population far In contrast to previous studies in terms of socio-economic, racial and cultural status. Therefore, some of the previously constructed items are no longer suitable for current research or there may be different structural items in the current study compared to structures that have been found in previous studies. Therefore, researchers need to recalculate the value of Internal Reliability for the current instrument of the new Cronbach Alpha value. Taking into consideration the recommendation by Awang (2010; 2012), researchers have decided to re-run EFA on items that measure their construction. This study will explain in detail the procedures for carrying out EFA analysis for each construct.
Keywords: Exploratory Factor Analysis (EFA), Structural Equation Modeling (SEM), Kaiser-Meyer-Olkin (KMO), Total Variance Explained, Factor Loading.

Introduction

Studies in the field of education are often conducted by researchers, but researchers rarely use the SEM study method to analyze the various relationships between variables in the model formed based on the theory under study. The validity and reliability of item questionnaires can sometimes be debated, as this technique is not appropriate when evaluating. Therefore, to generate the validity and reliability of the item questionnaire, the researcher must first apply the Exploratory Factor Analysis (EFA) process to obtain the items that are truly feasible for use in research instruments. This research will explain in detail the methods to obtain validity and reliability of item questionnaires by using EFA for measurement of motivation, learning styles and learning disciplines for additional mathematics subjects.

Exploratory Factor Analysis (EFA)

EFA is identifying the components that exist within the set of questionnaires that have been established. EFA is a statistical technique that converts a linearly constructed data set into a small construction set that can provide a thorough overview of all the information contained in the original construction (Duntemen, 1989). The goal of EFA is to reduce the dimensions of the original data to some smaller components and can be interpreted more easily and meaningfully (Duntemen, 1989; Lewis-Beck, 1994 & Field, 2006).

According to Tabachnick & Fidell (2007), EFA must go through several levels. The first rank calculates the correlation matrix between all construct analyzed by factors. The next stage eliminates several factors from the matrix correlation and determines the number of factors formed. Reversal of these factors is done to improve the interpretation so that factors are more meaningful and can be interpreted. The last and most important step in factor analysis is to interpret the results of the factors obtained and give the appropriate name for each factor.

The instruments used in this study have adapted the instruments that have been developed by some previous researchers based on additional mathematics subjects, as well as modifying some statements to suit the ongoing research. According to Awang (2010: 2012), Hoque et al (2016; 2017) & Noor et al. (2015), if a researcher adjusts the instruments previously set by the researchers and modifies statements appropriate to current research, then they must re-run the EFA procedure. This is because the current field of study may be different from previous studies, or the current research population is much different from previous studies in terms of socio-economic, racial and cultural status.

Therefore, there may be some items that were previously built, no longer appropriate for current research or there may also be different item structures in the current study compared to previous research structures. Therefore, researchers need to recalculate the value of Internal Reliability for the current instrument, the new Cronbach Alpha value (Awang, 2010: 2012; Hoque et al., 2016; 2017). In this study, researchers conducted a pilot study on 100 students Form 4 and ran an EFA on an item that measures construction by considering recommendations by Awang (2010; 2012) & Hoque et al. (2016, 2017).

Research Findings

Exploratory Factor Analysis (EFA) for Motivation Constructs

Building Motivation is measured using 8 items labelled as MD1 to ML8. Each item statement is measured using an Interval Scale of 1 to 10. The EFA procedure using Principal Component Analysis (PCA) with Varimax Rotation has been performed on 8 items that measure the construction of Motivation. The findings from Table 1 show that the Bartlet Test score is significant (P value <0.05). Measure Sampling Adequacy by Kaiser-Meyer-Olkin (KMO) is **0.723** which is above the minimum value of 0.6 (Awang, 2010; 2012 & Hoque et al., 2016; 2017). Both achievements (Significant Bartlet Test, and KMO value> 0.6) reflect observed data for subsequent procedures in EFA (Awang, 2010; 2012 & Hoque et al., 2016; 2017).

Table 1: Value of KMO and Bartlet Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**0.723**
Bartlett's Test of Sphericity	Approx. Chi-Square	237.236
	df	28
	Sig.	0.000

The Total Variance Explained is important for the researcher to know what percentage of items used can measure the study construction. Table 2 shows the total value of variance estimated by the items used to measure the construction of Motivation. The reading from Table 2 shows that the construction of motivation measured using 8 items in 2 components can measure the construction of the Motivation of 68.118%. This value is sufficient because it exceeds the minimum requirements of 60% (Awang, 2010; 2012 & Hoque et al., 2016; 2017).

Table 2: The Estimated Amount of Variance

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.137	39.217	39.217	3.137	39.217	39.217
2	2.512	28.901	68.118	2.512	28.901	**68.118**
Extraction Method: Principal Component Analysis.						

The findings from Table 2 show the construction of Motivation measured by two components only. Thus, the researcher wants to know the item chosen to measure the component. Table 3 shows the distribution of items received to measure the constructs of Motivation. All items have a factor loading exceeding the minimum limit of 0.6 as suggested by Awang (2010; 2012) & Hoque et al. (2016, 2017). Items weighing less than 0.6 should be excluded as they do not contribute to construction constructs (Awang, 2010; 2012 & Hoque et al., 2016; 2017). MD1 and ML8 items have a factor loading of less than 0.6 and are excluded from the questionnaire for further study.

Table 3: Items for components

Component Matrix[a]		
	Component	
	1	2
MD1	This item is disengaged	
MD2		0.699
MD3		0.778
MD4		0.784
ML5	0.783	
ML6	0.844	
ML7	0.850	
ML8	This item is disengaged	

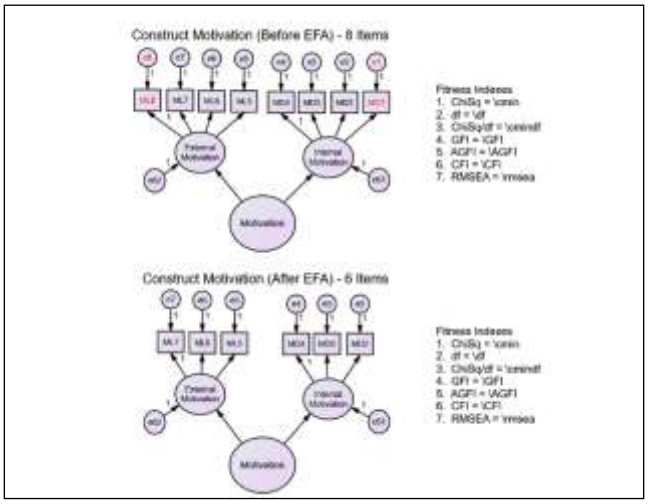

Figure 1: Component Position and Item for Motivation Construct (Before and After EFA)

Another information that should be reported by researchers is the reliability of items that have been built to measure the constructs. Measurement of instrument reliability is estimated through the Cronbach Alpha value. The Cronbach Alpha value of the instrument must exceed a minimum of 0.7 for adoption in this study. Table 4 shows the Cronbach Alpha value for each component of the Motivation construct. This construct has an Alpha Cronbach value exceeding the value of 0.7 and can be applied in this study (Awang, 2010; 2012).

Table 4: Instrument Reliability Value

Component	Number of Items	Cronbach's Alpha
1	3	0.808
2	3	0.797
Total	6	

Exploratory Factor Analysis (EFA) for Learning Style Constructs

Learning Style construct is measured using 45 items shortened GP9 to GGU53. Each item statement is measured using an Interval Scale of 1 to 10. EFA procedure with Principal Component Analysis (PCA) with Varimax Rotation has been performed on 45 items that measure Learning styles. The findings in Table 5 indicate that the Bartlet Test score is significant (P value <0.05). At the same time, the Measure of Sampling Sufficiency measure by Kaiser-Meyer-Olkin (KMO) is 0.877 which is above the minimum value of 0.6 (Awang, 2010: 2012; Hoque et al., 2016; 2017). These two achievements (Significant Bartlet Test, and KMO value> 0.6) reflect eligible data for subsequent procedures in EFA (Awang, 2010: 2012; Hoque et al., 2016; 2017).

Table 5: Value of KMO and Bartlett Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**0.877**
Bartlett's Test of Sphericity	Approx. Chi-Square	4120.009
	df	990
	Sig.	0.000

The Total Variance Explained is important for the researcher to know what percentage of items used can measure the study construction. Table 6 shows the total value of variance estimated by the item used to measure the Learning Style construct. The reading from Table 6 shows that the Learning Style construct measured using 4 components can measure the learning style 60.774%. This value is sufficient because it exceeds the minimum requirements of 60% (Awang, 2010; 2012 & Hoque et al., 2016; 2017).

Table 6: The Number of Components and Value of Variance Described

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	18.911	42.024	42.024	18.911	42.024	42.024
2	4.336	9.636	51.660	4.336	9.636	51.660
3	2.301	5.114	56.774	2.301	5.114	56.774
4	1.800	3.999	60.774	1.800	3.999	**60.774**
Extraction Method: Principal Component Analysis.						

The findings from Table 6 show the construction of a Learning Style measured by 4 components. Thus, the researcher wants to know the selected item to measure each component. Table 7 shows the distribution of items received to measure the Learning Style construct. All items have a factor loading exceeding the minimum limit of 0.6 as suggested by Awang (2010; 2012) and Hoque et al. (2016; 2017). Items with a factor loading of less than 0.6 should be excluded as they do not contribute to construction measurements (Awang, 2010; 2012 & Hoque et al., 2016; 2017).

Table 7: Number of Extracted Components

Rotated Component Matrix[a]				
	Component			
	1	2	3	4
GP9				0.843
GP10				0.845
GP11	This item is disengaged			
GP12				0.840
GP13				0.875
GP14			0.644	
GP15	This item is disengaged			
GP16			0.719	
GP17			0.692	
GP18			0.680	
GP19	This item is disengaged			
GP20	This item is disengaged			
GM21	This item is disengaged			
GM22	This item is disengaged			
GM23	This item is disengaged			
GM24		0.623		
GM25		0.629		
GM26		0.744		
GM27		0.742		
GM28		0.755		
GM29		0.720		
GM30		0.707		
GM31		0.784		
GM32		0.721		
GT33	This item is disengaged			
GT34	0.715			
GT35	This item is disengaged			
GT36	0.762			
GT37	0.814			
GT38	0.813			
GT39	0.798			
GT40	0.743			
GT41	This item is disengaged			
GT42	This item is disengaged			
GT43	This item is disengaged			
GT44	This item is disengaged			
GGU45	This item is disengaged			
GGU46	This item is disengaged			

GGU47	This item is disengaged			
GGU48	0.710			
GGU49	This item is disengaged			
GGU50	This item is disengaged			
GGU51	0.741			
GGU52	0.681			
GGU53	0.630			

Another information that will be reported by the researcher is the internal reliability value of the item that has been selected to measure the construct. Measurement of instrument reliability is estimated through the Cronbach Alpha value. The Cronbach Alpha value of the instrument must exceed a minimum of 0.7 for adoption in this study. Table 8 shows the Alpha Cronbach value for each Learning style component. This construction has an Alpha Cronbach value exceeding the value of 0.7 and can be applied in this study (Awang, 2010; 2012 & Hoque et al., 2016; 2017). Table 8 shows all the components that measure this construction to achieve the required internal reliability.

Table 8: Internal Reliability Values

Component	Number of Items	Alpha Cronbach
1	4	0.908
2	4	0.815
3	9	0.935
4	10	0.961
Total	27	

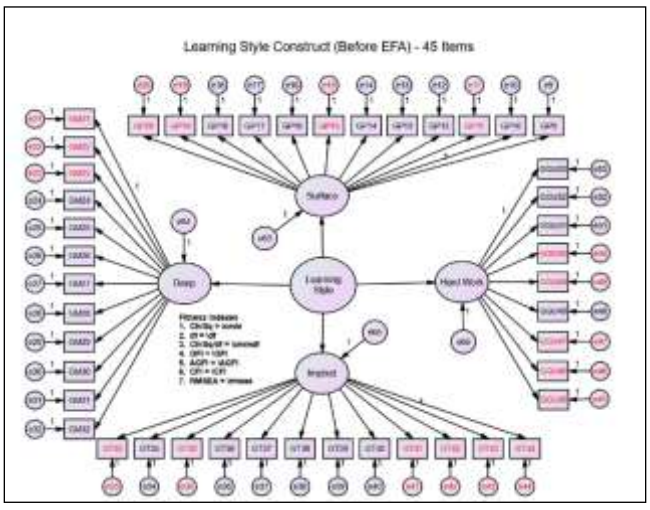

Figure 2: Component Position and Item for Learning Style Constructs (Before EFA)

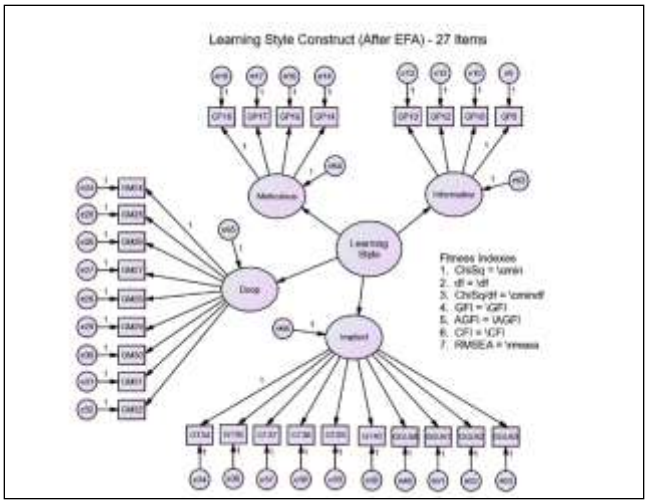

Figure 3: Component Position and Item for Learning Style Constructs (After EFA)

Exploratory Factor Analysis (EFA) for Learning Discipline Construct

Discipline Learning construct is measured using 7 items shortened DP54 to DP60. Each item statement is measured using an Interval Scale of 1 to 10. The EFA procedure using the Principal Component Analysis (PCA) method with Varimax Rotation has been performed on 7 items that measure the constructs of Learning Discourse. The findings in Table 9 indicate that the Bartlet Test score is significant (P value <0.05). At the same time, the Measure of Sampling Sufficiency measure by Kaiser-Meyer-Olkin (KMO) is **0.891** which is above the minimum value of 0.6 (Awang, 2010: 2012; Hoque et al., 2016; 2017). These two achievements (Significant Bartlet Test, and KMO value> 0.6) reflect eligible data for subsequent procedures in EFA (Awang, 2010: 2012; Hoque et al., 2016; 2017).

Table 9: Value of KMO and Bartlett Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**0.891**
Bartlett's Test of Sphericity	Approx. Chi-Square	436.473
	df	21
	Sig.	0.000

The Total Variance Explained is important for the researcher to know what percentage of items used can measure the study construction. Table 10 shows the total variance values estimated by the items used to measure the construction of the Learning Discipline. The reading from Table 10 found that the Learning Discipline construct measured using one component can measure the Learning Discipline concept of 64.307%. This value is sufficient because it exceeds the minimum requirements of 60% (Awang, 2010; 2012 & Hoque et al., 2016; 2017).

Table 10: Number of Components and Value of Variance Described

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.501	64.307	64.307	4.501	64.307	**64.307**
Extraction Method: Principal Component Analysis.						

The findings from Table 10 show the construct of the Learning Discipline as measured by one component. Thus, the researcher wants to know the selected item to measure each component. Table 11 shows the distribution of goods received to measure the construction of the Learning Discipline. All items have a factor loading exceeding the minimum limit of 0.6 as suggested by Awang (2010; 2012) & Hoque et al. (2016, 2017). Items with a factor loading of less than 0.6 should be excluded as they do not contribute to the construction (Awang, 2010; 2012 & Hoque et al., 2016; 2017).

Table 11: Number of Extracted Components

Component Matrix[a]	
	Component
	1
DP54	This item is disengaged
DP55	0.763
DP56	0.886
DP57	0.857
DP58	0.871
DP59	0.808
DP60	0.810

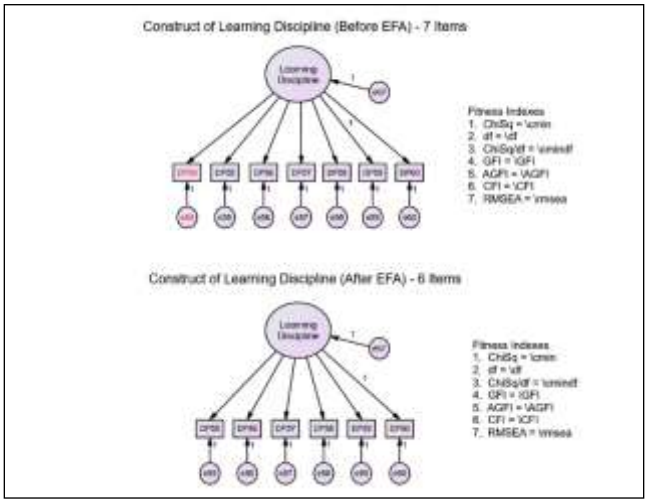

Figure 4: Component Position and Item for Learning Discipline Constructs (Before & After EFA)

Another information that will be reported by the researcher is the internal reliability value of the item that has been selected to measure the construct. Measurement of instrument reliability is estimated through the Cronbach Alpha value. The Cronbach Alpha value of the instrument must exceed a minimum of 0.7 for adoption in this study. Table 12 shows the Alpha Cronbach values for each Learning Discipline component. This construction has an Alpha Cronbach value exceeding the value of 0.7 and can be applied in this study (Awang, 2010; 2012 & Hoque et al., 2016; 2017). Table 12 shows all the components that measure this construction to achieve the required internal reliability.

Table 12: Internal Reliability Values

Component	Number of Items	Alpha Cronbach
1	6	0.912
Total	6	

Conclusion

Overall, the goods requirement in each construction as a whole meets Bartlet Test achievements (significant), KMO (> 0.6), factors loading exceeds the minimum threshold of 0.6 and Alpha Cronbach exceeds the minimum limit of 0.7 for adoption in this study. This reflects that the items not set aside are applicable in this study (Awang, 2010; 2012; Hoque et al., 2016; 2017). After applying EFA, items to build Motivation have decreased from 8 to 6, Learning Style items decreased from 45 to 27 and the Learning Discipline item decreased from 7 to 6. The total item of the instrument in this study decreased from 60 to 39.

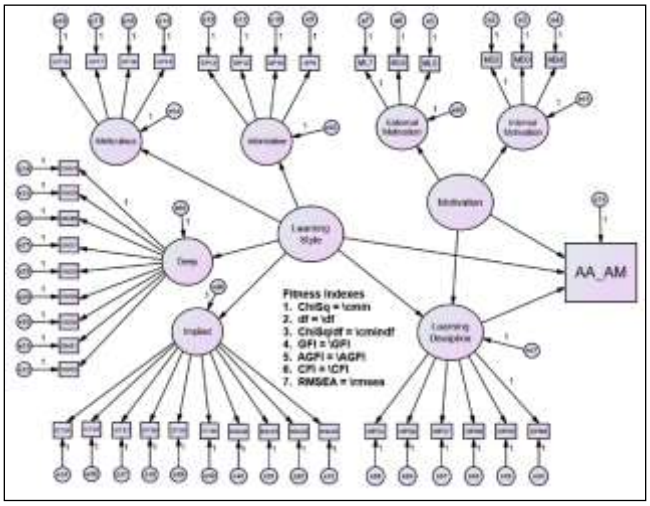

Figure 5: Overall Construct Model for Motivation, Learning Style and Learning Discipline After EFA

Acknowledgement

Special appreciation is owed to Universiti Sultan Zainal Abidin (UniSZA), Research Management, Innovation & Commercialization Centre (RMIC) UniSZA & Ministry of Higher Education Malaysia (MOHE).

Corresponding Author
Abdul Hakim Abdullah, Faculty of Islamic Contemporary Studies, Universiti Sultan Zainal Abidin, Kuala Terengganu, MALAYSIA. Email: hakimabd@unisza.edu.my

References

Awang, Z. (2010). Research Methodology for Business and Social Sciences. *Kelantan: Universiti Teknologi MARA*.

Awang, Z. (2012). *Structural equation modeling using AMOS graphic*. Penerbit Universiti Teknologi MARA.

Duntemen, G. H. (1989). *Principles components analysis: Quantitative applications in the social sciences*. California: Sage Publications, Inc.

Field, A. (2006). *Discovering statistics using SPSS*. London: Sage Publications Ltd.

Hoque, A. S. M. M., & Awang, Z. (2016). *The Exploratory Factor Analysis (EFA) of Entrepreneurial Marketing Scale - Development and Validation*. Tourism Conference 20-22 APRIL 2016 (p. 22).

Hoque, A. S. M. M., Awang, Z., Jusoff, K., Salleh, F., & Muda, H. (2017). Social Business Efficiency: Instrument Development and Validation Procedure using Structural Equation Modelling. *International Business Management,* 11(1), 222-231.

Lewis-Beck, M. S. (1994). *Factor analysis and related techniques*. London: Sage Publication, Ltd.

Noor, N. M., Aziz, A. A., Mostapa, M. R., & Awang, Z. (2015). *Validation of the Malay version of the Inventory of Functional Status after Childbirth questionnaire*. BioMed research international, 2015.

Selmes, I. P. (1987). *Improving study skills: Changing perspective in education.* Great Britain: Hodder and Stoughton Ltd.

Tabachnick, B. G., & Fidell L. S. (2007). *Using multivariate statistics (5th ed.)*. Boston: Pearson Education Inc.