VALIDATION OF THE ACADEMIC INERTIA SCALE ON ENGINEERING UNDERGRADUATES IN THE INDIAN CONTEXT

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ABSTRACT

The current study was conducted to validate the Academic Inertia scale developed by Deemer, Derosa, Duhon and Dotterer (2021) in the Indian context. The sample of the study consisted of 303 students of second year undergraduates of "School of Computer Science and Engineering, School of Mechanical Engineering and School of Electrical Engineering of Lovely Professional University", Phagwara, Punjab, India. "Exploratory factor analysis, conducted using SPSS Statistics Ver. 23.0 software", extracted the original two dimensions, Lower momentum state of Inertia (LMSI) and Higher momentum state of Inertia (HMSI). "Confirmatory factor analysis" was used to validate the factor structure of Academic Inertia with the help of "SPSS AMOS Ver. 23.0" software. The goodness of fit indices like "CMIN/DF, GFI, TLI, CFI, RMR, RMSEA" had good estimates displaying construct validity. The Lower momentum state of Inertia (LMSI) correlated positively and significantly with academic procrastination and Higher momentum state of Inertia (HMSI) correlated positively and significantly with engineering self-efficacy indicating nomological construct validity. The internal consistency reliability of the variable was calculated using Cronbach's Alpha and the coefficients obtained for both the dimensions, LMSI (0.925) and HMSI (0.893), and of the total scale (0.756) were acceptable. The educational implications of the study are discussed in the context of engineering education in the Indian context.

Keywords: *Academic Inertia, Lower momentum State of Inertia (LMSI), Higher Momentum State of Inertia (HMSI), Engineering Education, Engineering Undergraduates.*

In Physics, Newton's second law of motion states that when an external force is applied to a system, its velocity changes with respect to time in a proportional manner, with the constant of proportionality being the object's mass, which is a measure of its inherent property of inertia. Drawing a parallel, in Psychology, the Psychological Momentum Theory (PMT) (Hubbard, 2010, 2015; Markman and Guenther, 2007; Nevin, Mandell and Atak, 1983) describes the relationship that manifests between the resistance to change in behaviour and number of times of occurrence of that given behaviour in the presence of a stimulus, similar to the what happens to a massive object's velocity in the presence of force.

The Psychological momentum theory indirectly presents a parallel of the physical quantity momentum by defining mass (which is the measure of inertia of a body) with the help of the response rate (velocity). In psychological terms, an individual who is not after the completion of a given task all his or her energy is treated to be possessing low momentum and be in a low momentum state (LMS), while an individual who wholeheartedly pursues a task towards its completion is treated to be in a high momentum state (HMS). Thus, the variable psychological momentum indicates a state involving complete placement of efforts by individuals. Such researchers indicate that the scientific community is showing enough interest in disclosing analogies between physical and psychological phenomena and their variables (Markman and Guenther, 2007; Nevin and Grace, 2000).

As such, the construct of Psychological

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momentum has seen enough work in the field of sports (Briki, Hartigh, Markman, Micallef and Gernigon, 2013) and experimental psychology literatures, but not much is known on how the variables fairs in other domains like education. To address this very gap, recently, Deemer, Derosa, Duhon and Dotterer (2021) proposed the construct academic momentum in the context of academic domain along proposing the variable psychological mass (defined as “the degree to which the individual ascribes value to a given behaviour”, Markman and Guenther (2007), which causes inertia, and is the predictor of academic momentum. They also proposed the construct academic inertia and conceptually defined it as “tendency to remain in a status quo state of academic behaviour”. Since inertia is associated with the state of rest (momentum is zero) as well as the state of motion (momentum is non-zero), academic inertia also correspondingly has two states, namely, “High momentum state of inertia (HMSI)” and “Low momentum state of inertia (LMSI)”. They considered the variable “Inspiration” to be the psychological analogue of physical force, to examine the academic analogue of Psychological momentum theory.

Since the **study was preliminary in nature** with the proposed variables, they conducted **hierarchical regression analysis** to examine whether inspiration moderate the relationship between LMSI and HMSI. Since academic procrastination is idea-wise similar to LMSI and self-efficacy is a proven predictor of HMSI (Jones and Harwood, 2008), they also conducted the analysis of correlational relationships among these variables in their study, apart from construction and validation of the tool for measuring academic inertia / momentum.

Tool adoption, involving usage of a foreign origin tool in a local context, is an economical practice over construction of it from scratch, as it saves time, money and effort (Gjersing, Caplehorn and Clausen, 2010). According to Hambleton (2005) such practices would pick up pace in future leading to a rise in cross cultural research. However, such studies would require thorough validation of the instruments in the local settings owing to cultural sensitivity of the variable of interest (Yasir, 2016). Trading on these lines, in the current study, the academic inertia scale developed by Deemer, Derosa, Duhon and Dotterer (2021) was validated in the Indian context by the researchers.

Operational Definition

Academic Inertia: Academic Inertia is defined as “the tendency to remain in a status quo state of academic behavior” Deemer, Derosa, Duhon and Dotterer (2021).

Methodology

Sample

The study consisted of 303 students of second year undergraduates of School of Computer Science and Engineering, School of Mechanical Engineering, School of Electrical Engineering, Lovely Professional University, Phagwara, Punjab, India. Engineering students, especially in their second year, were selected as the sample in this study, because they are found to suffer from academic inactivity on returning to the college campus after the first year (McBurnie, Campbell and West, 2012; Gardner, 2000), technically studied under the phenomenon of Sophomore slump (Freedman, 1956; Chasmer et al., 2015) and hence experience being in lower momentum state of inertia. Also, the second year engineering students are the most neglected lot when compared to the first year, third year or the final year students of engineering (Tobolowsky, 2008), thus forming the optimal representation of a population for academic inertia estimation. The sample was selected using a simple random probability sampling technique.

Instrument: Academic Inertia Scale

Nine items were prepared by the original author with the intention of reflecting the two-factor model of inertia in the academic fields of science and engineering. These two factors were lower momentum state of inertia (LMSI) and the higher momentum state of Inertia (HMSI). Each item’s responses were provided in a five point Likert-Scale, where the options were 1-Strongly Disagree, 2-Disagree, 3- Neutral, 4-Agree, 5- Strongly Agree.

Procedure

Permission to conduct a validation study on the Academic Inertia tool in Indian context was taken from the original author Eric D. Deemer through an e-mail. The researchers approached the head of the department of the School of Computer Science and Engineering, School of Mechanical Engineering, School of Electrical Engineering, Lovely Professional University, Phagwara, Punjab, India and asked for the permission to administer the tool on the second year undergraduates. The purpose of the visit was explained to the students. The instructions on the filling of the responses in google form were clearly given to the subjects. The subjects took ten to fifteen minutes to fill the google form questionnaire.

Results

The researchers initiated the data analysis by conducting descriptive statistics estimation, followed by exploratory factor analysis EFA of the adopted tool. EFA was conducted using SPSS Statistics software Ver. 23.0 under principal component analysis with Varimax rotation. The determinant was 0.000 indicating that the data is good enough to undergo factor analysis. The KMO sampling adequacy was adequate at 0.850 indicating the sample of n=103 was sufficient for the study. The Barlett's test of sphericity was significant, which meant that the items covaried with each other. For conducting further research, the item total correlation of the items was analyzed.

Descriptive statistics

	Mean	Std. Deviation	Analysis N	Missing N
LMSI1	2.8155	.99752	103	0
LMSI2	2.7184	.94368	103	0
LMSI3	2.5825	1.08034	103	0
LMSI4	2.6117	.92071	103	0
LMSI5	2.6602	.97572	103	0
HMSI6	4.0097	.70704	103	0
HMSI7	4.0291	.69249	103	0
HMSI8	3.9320	.66069	103	0
HMSI9	3.8932	.67027	103	0

Table 1 Descriptive Statistics of dimensions of Academic Inertia

Correlation Matrix[a]

		LMSI1	LMSI2	LMSI3	LMSI4	LMSI5	HMSI6	HMSI7	HMSI8	HMSI9
Correlation	LMSI1	1.000	.788	.665	.636	.650	-.262	-.304	-.183	-.147
	LMSI2	.788	1.000	.739	.730	.736	-.246	-.257	-.220	-.203
	LMSI3	.665	.739	1.000	.772	.701	-.316	-.272	-.287	-.198
	LMSI4	.636	.730	.772	1.000	.725	-.250	-.228	-.237	-.147
	LMSI5	.650	.736	.701	.725	1.000	-.166	-.116	-.173	-.206
	HMSI6	-.262	-.246	-.316	-.250	-.166	1.000	.740	.652	.623
	HMSI7	-.304	-.257	-.272	-.228	-.116	.740	1.000	.669	.640
	HMSI8	-.183	-.220	-.287	-.237	-.173	.652	.669	1.000	.736
	HMSI9	-.147	-.203	-.198	-.147	-.206	.623	.640	.736	1.000
Sig. (1-tailed)	LMSI1		.000	.000	.000	.000	.004	.001	.032	.069
	LMSI2	.000		.000	.000	.000	.006	.004	.013	.020
	LMSI3	.000	.000		.000	.000	.001	.003	.002	.023
	LMSI4	.000	.000	.000		.000	.005	.010	.008	.069
	LMSI5	.000	.000	.000	.000		.047	.122	.040	.018
	HMSI6	.004	.006	.001	.005	.047		.000	.000	.000
	HMSI7	.001	.004	.003	.010	.122	.000		.000	.000
	HMSI8	.032	.013	.002	.008	.040	.000	.000		.000
	HMSI9	.069	.020	.023	.069	.018	.000	.000	.000	

a. Determinant = .001

Table 2- Correlation of the Items of Academic Inertia

All the items of the tools were retained because the item –item correlation was significant. Also, the KMO and Bartletts value was comes out to be significant as shown below:

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.850
Bartlett's Test of Sphericity	Approx. Chi-Square	645.638
	df	36
	Sig.	.000

Table 3 Sampling Adequacy Test

Rotated Component Matrix[a]

	Component 1	Component 2
LMSI2	.900	
LMSI4	.872	
LMSI5	.869	
LMSI3	.864	
LMSI1	.839	
HMSI8		.870
HMSI7		.865
HMSI9		.858
HMSI6		.850

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization. [a]

a. Rotation converged in 3 iterations.

Table 4 Extracted Factor Structure with Factor Loadings

When confirmatory factor analysis CFA was conducted, the goodness of fit estimates were found to meet the expected level. SPSS AMOS software version 23.0 was used to conduct the exercise. The path diagram below shows how the items are related with the two dimensions in the form of a first order structure and factor loadings as shown below:

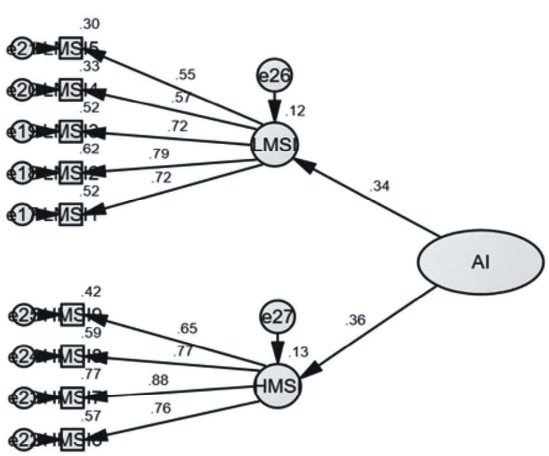

Fig.1: **Confirmatory Factor Analysis Output of Academic Inertia**

Estimands	Cmin/Df	SRMR	RMSEA	CFI	TLI
Benchmarks	<3	<0.08	<0.08	>0.9	>0.9
Model output	1.498	0.0723	0.050	0.910	0.901

The hypothesized model of the relationship between Academic Inertia, and its dimension LMSI and HMSI for Engineering Undergraduates was found to empirically fit well with the collected data since goodness of fit indices were found to satisfy their respective benchmarks except "SRMR". The "CFI" and "TLI" obtained values were above the benchmark of 0.9, and the "RMSEA" and "Cmin/Df" obtained values were also found to be less than their respective benchmarks of 0.08 and 3 according to Hu and Bentler (1998). Also, "SRMR" value was found to be less than its benchmark of 0.08. The factor loading of each of items on their respective factor was moderately strong with the magnitude above 0.5. These estimates of the goodness of fit indices indicate construct validity of the scale.

Nomological Construct Validity testing

Correlations

		AP	LMSI
Pearson Correlation	AP	1.000	.240
	LMSI	.240	1.000
Sig. (1-tailed)	AP	.	.000
	LMSI	.000	.
N	AP	200	200
	LMSI	200	200

Table 5 Correlation of LMSI with AP

The relationship of lower momentum state of inertia with academic procrastination (measured using Yockey, 2016) was found to be positive in nature and weak in magnitude with Pearson product moment coefficient r= 0.240, but significant with p-value = 0.000, in line with the findings of the previous study Deemer, Derosa, Duhon and Dotterer (2021)).

Correlations

		ESE	HMSI
Pearson Correlation	ESE	1.000	.388
	HMSI	.388	1.000
Sig. (1-tailed)	ESE	.	.000
	HMSI	.000	.
N	ESE	200	200
	HMSI	200	200

Table 6 Correlation of HMSI with ESE

The relationship of higher momentum state of inertia with engineering self-efficacy (measured using the scale Mamaril et al., 2016) was found to be positive in nature and moderate in magnitude with Pearson product moment coefficient r= 0.388, but significant with p-value = 0.000, in line with the findings of the previous study Deemer, Derosa, Duhon and Dotterer (2021). Both the above findings display the nomological construct validity of academic inertia.

Reliability Analysis

In tool validation, reliability analysis is an important aspect. To measure that reliability researchers calculated Cronbach's alpha for both the dimensions individually. Value of reliability is 0.893 for Higher momentum state of inertia and 0.925 for Lower Momentum State of Inertia. The reliability of the total scale with 9 items was acceptable at 0.756

Reliability Statistics	
Cronbach's Alpha	N of Items
.925	5

Table 7 Reliability of HMSI Dimension of Academic Inertia

Reliability Statistics	
Cronbach's Alpha	N of Items
.756	9

Table 8 Reliability of Academic

Discussion

Yasir (2016) mentioned the need of validating any foreign origin tool in the local context, owing to the influence of culture on the item statements of the tool. This observation makes it necessary to take up validation exercises of psychological tools. The researchers took one such exercise to validate the newly developed academic inertia scale by Deemer, Derosa, Duhon and Dotterer (2021) in Indian context on Engineering undergraduates. The original factor structure of two dimensions was extracted and the later confirmed using confirmatory factor analysis goodness of fit indices estimates being fine indicating the congruence between the hypothesized two factor structure of academic inertia with the empirically obtained data. Lower momentum state of inertia was found to positively correlate with academic procrastination and higher momentum state of inertia correlated well with engineering self -efficacy, indicating the scale possesses nomological construct validity. The scale showed acceptable internal consistency reliability with Cronbach alpha of the scale and its two dimensions being acceptable. The tool's good psychometric performance on engineering undergraduates of India, would aid in measurement of this vital variable academic inertia of engineering education, especially in addressing the issue of sophomore slump observed in the second year of this professional study. Quantitative analysis of academic inertia would now be possible to conduct with availability of an adapted tool in the Indian context, with which the researchers of engineering education can further analyze the variable and its presence as a trait in the undergraduates pursuing this professional education. Availability of quantitative results can further aid the faculty members in the engineering education design and incorporate interventions to promote high momentum state of inertia, once attained by the students and identify and elevate the students from lower momentum state of inertia. Positive and significant correlation of lower momentum state of inertia with academic procrastination further necessitates focusing of the instructional resources towards mitigation of the lower momentum state of inertia or lack of productive activity by the engineering undergraduates. Engineering self-efficacy promotion would ensure the students of engineering attain and maintain a higher momentum state of inertia which is highly desirable in the 21st century where these professionals are expected to be self-regulated and lifelong learners for remaining professionally relevant in the workforce. Moreover, it is contextual here to also mention that India become a signatory of the elite group of nations under Washington Accord in June 2014, which enables mobility of professional engineers from one member nation to another mention nation to pursue professional practice, owing to the cultivation of common engineering graduate requirements in the students of these nations during the study, who must not just be self-regulated learners, but also lifelong learners as per the 12th point of this agreement (Pp:15, The Washington Accord Graduate Attribute Profile). Hence, the significance of the availability of a locally adapted tool to measure academic inertia in Indian engineering undergraduates is contexualized.

Limitations

The subjects of the study were mostly from the mechanical and computer science and electronics engineering departments of Lovely Professional University of Doaba region only. The study can be further extended to other engineering, technology, science and mathematics population undergraduates of the STEM cohort. Also, the study concluded at mere validation of the construct using confirmatory factor analysis. However, the measurement invariance testing of the scale remains to be estimated in the future study especially in a culturally diverse nation like India.

Conclusion

The academic inertia scale is validated in the Indian context, with the original two factor structure and items retained in this adaptation study. The validated tool is hoped to serve as the means in measuring a critical engineering educational variable like academic inertia and hence pave the way for further research in engineering education in the country.

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