

Design and Validation of the Academic Research Aptitude Scale

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Abstract : Universities across the world have now started focusing on creating and nurturing academic researchers. While the importance and benefits of a strong research mindset have been understood, the process of identifying and developing researchers lacks a sense of structure. The current study attempts at filling this gap by proposing and testing the Academic Research Aptitude Scale. The scale was created and tested using the DeVellis (2016) method. The initial pool of items consisted of 29 items that were generated in the course of a brainstorming session. The discussion with experts and literature review resulted in a 22-item instrument which was then reduced to 21 items, post the item analysis. The analysis was carried out on a sample of 303 research scholars and researchers. The exploratory factor analysis helped in the identification of the dimensions and the same was then checked using confirmatory factor analysis. The scale fulfilled the validity requirements and showed high reliability, as shown by

Cronbach's alpha score. The final scale consists of 21 items.

Keywords: researchers; research scholars; academics; India

1. Introduction

Academic research has been held in high regard for decades. Jaffe (1989) proposed that there exists a correlation between corporate innovativeness, design thinking and proximity to major research universities. Jaffe (1989) cites the example of Silicon Valley and its proximity to Stanford as an example of this spillover effect. This school of thought suggests that to sustain advancement in the corporate world, there must be rigour and focus on developing the academic research potential and research quality.

Researchers must be capable of creating detailed plans for their research work, they must also be flexible to account for any setbacks. They must be task-oriented and still ensure that the work takes into consideration the feelings of the target population. This complexity in the desired aptitude makes the identification and evaluation of a person's research competency extremely difficult. This study attempts to assist in this process by designing and validating an instrument to measure research aptitude, given that competencies can be developed if the inclination and ability exist.

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2. Literature Review

As the need for academic researchers rises and universities look at increasing their research talent pool, the process of selection and development of researchers has become crucial. The current study attempts to provide an objective tool for the selection and identification of academic researchers. The tool may also be used as a development instrument to identify the gaps and aid in the development of research scholars.

A search for “research aptitude” did not return any results. Thus, the researchers chose to study the competencies of an academic researcher and use the same to identify an academic research aptitude framework. While there is a consensus that any model for research aptitude must be flexible to take into account the changing requirements of research, some attempts have been made at identifying competency frameworks for research (Research competencies framework, 2007). Showman, Cat, Cook, Holloway, and Wittman (2013) proposed that the traits that would enable an individual to successfully solve a research problem include being organized, good judgment, effective communication, creativity and being persistence. A document published by the Faculty of General Dental Practices, UK suggests that research competencies may be categorised into domains such as practical skills, problem-solving, thinking and communication skills, personal attitudes and professional ethics, dissemination and roles and functions. The dimension of practical skills comprises the ability to find and use resources and facilities like the library and information technology; recognise and identify the use of secondary and primary resources, observe and record behaviours and demonstrate technology usage competency. These skills are associated with the process of conducting research and may be considered basic requirements. While the ability to use information technology and computers is considered essential in this age of technology, the other need for skills of being able to identify and collect information is still relevant. These would be reflected in traits like curiosity, analytical ability and task orientation, which are related to how a researcher approaches and carries out the research. Thus, these traits are likely to reflect the individual's research aptitude.

Curiosity has always been associated with any task that involves inquisitive thinking (Berlyne, 1954). According to Zuss (2012), an individual derives the

desire to learn and acquire knowledge and skills from the quality of curiosity. Thus, in addition to being considered as a quality, curiosity is also regarded as a behaviour that enables constant learning and seeking of knowledge.

Analytical ability refers to the ability to collect the right information, analyse the information and make appropriate decisions or solve problems (Doyle, 2019). This covers the first dimension as well as some aspects of the dimension of thinking and problem-solving. While the ability to find and use various sources is crucial, the advances in technology have made the task simple for those who are motivated to do so. The key requirement is to identify the appropriate or right information. Analytical ability becomes especially critical in this era of information overload.

While the construct of task orientation has been primarily studied in relationship to leadership styles, Ebert, Griffin and Stark (2011) suggest that an individual who is considered task-oriented would ensure the creation of structures and plans to achieve the goals that have been set out. While it may not be considered a desirable leadership style (Bass, 1990), as a researcher it would ensure that research activities are planned and completed in a timely manner and oriented towards the final goal.

The personality traits that a researcher is expected to possess are similar to the concepts explained by Goleman (1998), in their study of emotional intelligence. Achievement orientation would allow the researcher to progress in their chosen field. Achievement orientation provides the individual with the ability to comprehend and react to the situations and tasks accordingly (Dweck & Leggett, 1988). Goleman, Boyatzis, Davidson & Druskat, (2017) explain achievement orientation as part of the Emotional Intelligence competencies. They suggest that achievement orientation allows an individual to "meet or exceed a standard of excellence, welcoming feedback, and continually seeking to improve." The given definition brings into focus the need to aim for excellence and quality work, suggesting that the individual must be willing to go the extra mile to create quality work. The second part of the definition calls for openness towards feedback. The last part of the definition suggests that the individual must be inclined to constant learning and growth by continuously being open to ideas and information that may emerge. The qualities have been studied in the

context of leadership skills but the researchers find that the same would hold for academic researchers too.

While substantial research has been done to develop and understand the various competencies, there is no tool to measure the aptitude for academic research. In the current study, the researchers attempt to fill this gap by attempting to develop one such tool. The understanding of the basic competencies, reviewed in this section, guide the process of identifying the personality traits that would indicate an aptitude for academic research.

3. Method

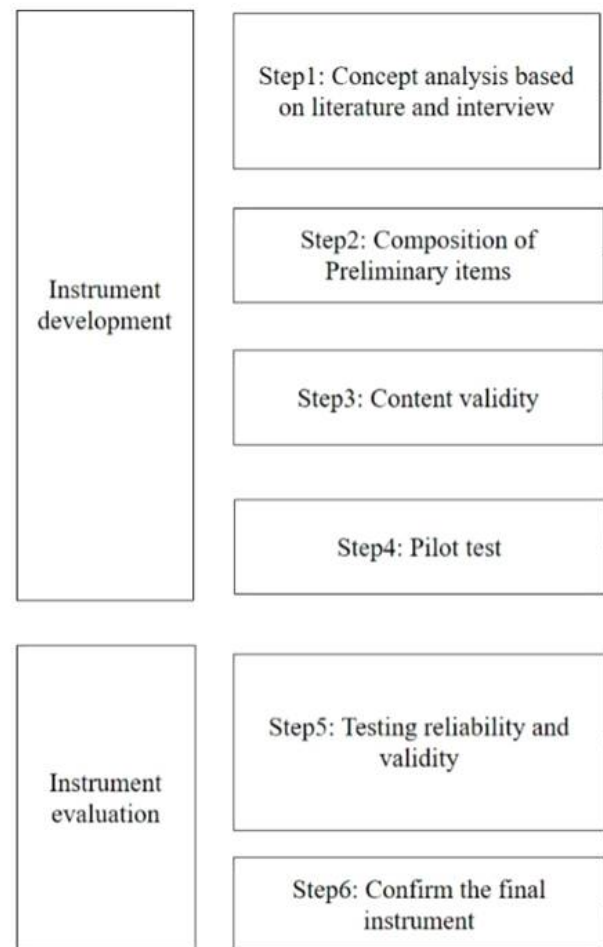
The study uses the DeVellis (2016) method for scale development. The steps of the process have been shown in Figure 1. The first step involves defining the construct. Since the construct is new and the researchers were not able to find a definition for the construct of Research Aptitude, an operational definition was arrived at through discussions with experts and a review of the literature.

The second step was the creation of an item pool. This was done through a brainstorming session. The initial pool was then refined based on inputs from experts. This was the step of content validity. Post the content validity step, the items were refined and a Likert scale was chosen, given the ease of administering and the advice of the experts.

The initial pilot test was carried out to ensure that there were no major issues in terms of difficulty in understanding the statements and the distribution of the responses. Post the pilot study, the instrument was made available to a large sample of researchers and research scholars. The data was then analysed for reliability and validity. In addition, exploratory factor analysis was used to reveal the loading of the indicators onto the respective dimensions or sub-constructs. The dimensions were then labelled based on the review of the literature

The final sample comprised of 303 respondents. This fulfilled the sample requirements for exploratory factor analysis and confirmatory factor analysis. As per Kline (2011), a minimum sample requirement of 200 is required for confirmatory factor analysis. Thus, the researchers aimed to get a sample size greater than 200. However, since the final sample comprised of 303 respondents, the exploratory factor analysis and

confirmatory factor analysis was carried out on the same dataset (Shyamamala, Oh, Cho & Im, 2021).



Source: Shyamamala, Oh, Cho & Im (2021)

Results **Fig. 1: Scale development process**

The analysis of the data was carried out to check the reliability and validity of the scale. In addition, the researchers also used an exploratory factor analysis to identify the dimensions of the scale. The dimensions were then confirmed using a confirmatory factor analysis.

- Concept Analysis

The first step of the process involved the review of related literature. The review of literature helped the researchers arrive at a definition for the concept. Research aptitude may be defined as an individual's natural ability and interest to participate in research activities. Having defined the concept, the researchers focused on identifying the possible dimensions of the scale.

Drawing from a model provided by the Faculty of General Dental Practices, UK, the researchers identified four probable dimensions of Achievement Orientation (AO), Task Orientation (TO), Curiosity (C) and Analytical Ability (AAb). The researchers then proceeded to create a pool of items for the scale. Through the process of brainstorming, the researchers arrived at a pool of 29 items.

- Content Validity

Content validity of the scale was established by a panel of 9 experts. Four experts were chosen from the field of research, four experts included those who were currently involved in the process of selecting and training research scholars. One language expert was chosen to ensure that the statements were correctly worded. The statements were then modified based on the feedback of the experts. Those statements that were labelled as not essential were discussed and post discussion, if the statements were still found to be not relevant, they were dropped from the instrument. Twenty-two statements were retained after this step.

- Characteristics of the participants

The final sample comprised of 303 respondents. The sample consisted of researchers and research students or research scholars, who were currently enrolled in the doctoral program of a recognized university. Table 1 provides the distribution of the sample based on gender and designation.

Table 1: Distribution of the sample

Category	%	n
Gender		
Male	28.5	71
Female	40.6	101
Prefer not to say	30.9	77
Designation		
Researcher	14.8	36
Research Scholar	85.2	207

- Item Analysis

This step involved the analysis of each statement or indicator. All items were found to have a skewness

and kurtosis value within the acceptable range of +3 and -3 (Kline, 2005). This would suggest that the data could be considered normally distributed. Each item was then analysed to check for correlation with the overall score. The total score for the Academic Research Aptitude Scale has been represented by the term ARAS and the individual scores were represented by the statement number, for example, ARAS1, ARAS2 etc. All the individual items were found to be significantly correlated to the overall score of the individual, except for ARAS8. Thus, ARAS8 or the eighth statement was dropped from the instrument. Thus, at end of this step, the total number of items was 21. The correlations have been presented in Table 2.

Table 2: Item and total score correlation

Indicator	ARAS	Indicator	ARAS
ARAS1	Pearson Correlation .441** Sig. (2-tailed) .000	ARAS12	Pearson Correlation .460** Sig. (2-tailed) .000
ARAS2	Pearson Correlation .433** Sig. (2-tailed) .000	ARAS13	Pearson Correlation .350** Sig. (2-tailed) .000
ARAS3	Pearson Correlation .436** Sig. (2-tailed) .000	ARAS14	Pearson Correlation .428** Sig. (2-tailed) .000
ARAS4	Pearson Correlation .423** Sig. (2-tailed) .000	ARAS15	Pearson Correlation .326** Sig. (2-tailed) .000
ARAS5	Pearson Correlation .493** Sig. (2-tailed) .000	ARAS16	Pearson Correlation .383** Sig. (2-tailed) .000
ARAS6	Pearson Correlation .384** Sig. (2-tailed) .000	ARAS17	Pearson Correlation .324** Sig. (2-tailed) .000
ARAS7	Pearson Correlation .444** Sig. (2-tailed) .000	ARAS18	Pearson Correlation .468** Sig. (2-tailed) .000
ARAS8	Pearson Correlation .086 Sig. (2-tailed) .137	ARAS19	Pearson Correlation .195** Sig. (2-tailed) .001
ARAS9	Pearson Correlation .323** Sig. (2-tailed) .000	ARAS20	Pearson Correlation .303** Sig. (2-tailed) .000
ARAS10	Pearson Correlation .398** Sig. (2-tailed) .000	ARAS21	Pearson Correlation .351** Sig. (2-tailed) .000
ARAS11	Pearson Correlation .385** Sig. (2-tailed) .000	ARAS22	Pearson Correlation .479** Sig. (2-tailed) .000

- Exploratory Factor Analysis

The next step involved was running an exploratory factor analysis to identify the dimensions. The results of the analysis have been presented in Table 3, Table 4. The Kaiser-Meyer-Olkin Measure of Sampling

Table 4: Kaiser-Meyer-Olkin Measure of Sampling Adequacy and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.			.868
Bartlett's Test of Sphericity	Approx. Chi-Square	1402.330	
	df	210	
Sig.			.000

Adequacy score suggests that the sample was adequate for the analysis. The significance of Bartlett's Test of Sphericity suggests that there exists at least one strong correlation among the items.

Table 4: Rotated Component Matrix

	Component			
	1	2	3	4
ARAS7	0.506			
ARAS9	0.475			
ARAS12	0.403			
ARAS14	0.619			
ARAS15	0.661			
ARAS16	0.589			
ARAS18	0.597			
ARAS19	0.495			
ARAS22	0.408			
ARAS2		0.415		
ARAS3		0.447		
ARAS4		0.622		
ARAS11		0.714		
ARAS6			0.549	
ARAS10			0.459	
ARAS13			0.521	
ARAS20			0.483	
ARAS21			0.718	
ARAS1				0.654
ARAS5				0.526
ARAS17				0.668

The results of the exploratory factor analysis revealed that the data was sufficient. The exploratory factor analysis was conducted using the principal component method using varimax orthogonal rotation. The first factor comprised of 9 indicators, the second factor comprised of four factors, the third factor comprised of 5 indicators and the fourth factor comprised of 3 indicators. The rotated component matrix mapped the statements to four proposed dimensions. The statements under each dimension were further analysed to identify and label the dimension. The

Table 5: Dimensions of the Academic Research Aptitude Scale (ARAS)

Dimension	Items
Achievement Orientation	I am open to new information
	I believe in having flexibility in my plans
	I am comfortable receiving feedback
	Sometimes listening is more important than speaking
	I take care to consider others' feelings
	I believe in giving credit when deserved
	I believe in going the extra mile
Curiosity	I work better when I am given guidelines
	I am excited at the prospect of sharing my knowledge
	I don't accept information without justification
	I am comfortable with raising questions
	I find it easy to put my ideas on paper
Task Orientation	When I learn something new, I am keen to find out more.
	I am comfortable asking for help
	I always get tasks done on time
	I don't allow my biases to cloud my judgement
	I believe in setting my own timelines
Analytical Ability	I do not allow setbacks to bother me
	I enjoy tasks that require in-depth analysis
	I enjoy finding patterns
	I enjoy working with numbers

dimensions along with the statements have been presented in Table 5.

- Confirmatory Factor Analysis

Confirmatory factor analysis was carried out to assess the latent construct. confirmatory factor analysis was also used to the goodness-of-fit, convergent validity and discriminant validity. The fit indices of the model have been presented in Table 6.

Table 6: Model fit indices

	(χ^2/df)	GFI	AGFI	RMR	RMSEA
Model Value	1.799	0.908	0.884	0.044	0.050
Accepted Value	< 3	> 0.90	> 0.80	<0.05	<0.10

The model fit indices reveal that the model is a good fit. All the goodness-of-fit indices were found to meet the required criteria and the RMR and RMSEA values were found to be below the threshold limit. The validity scores have been presented in Table 7.

Convergent validity was assessed from the CR

Table 7: Measures of validity

	CR	AVE	Fornell-Larcker Criterion			
			AO	C	TO	AAb
AO	0.85	0.454	0.674			
C	0.81	0.514	0.692	0.717		
TO	0.80	0.501	0.507	0.546	0.708	
AAb	0.81	0.589	0.606	0.609	0.299	0.767

or Composite Reliability scores and the AVE or the average variance extracted score. The CR score of all the dimensions was found to be above the acceptable value of 0.7 (Brown, 2015). The AVE scores of Curiosity (C), Task Orientation (TO) and Analytical Ability (AAb) were found to be above the threshold value of 0.5 (Brown, 2015). The AVE score of Achievement Orientation was found to be 0.45. However, according to Fornell and Larcker (1981), if the AVE of the variable is slightly less than 0.5 but the CR score is greater than 0.7, the convergent validity may be considered adequate.

- Reliability Testing

The last step involved analysis of reliability. The Cronbach's alpha value for the overall scale indicated that the Academic Research Aptitude Scale or ARAS had high reliability ($=0.85$). Table 8 presents the results of the reliability analysis of the overall scale with 21 items.

Table 8: Reliability analysis

Cronbach's Alpha	N of Items
.846	21

Discussion

The growth in academic research is evident from the fact that more and more students are choosing careers in research. The growth of research is critical for the creation of knowledge; a primary expectation from any academic institution. However, research is one such area, where quality, most definitely, trumps quantity. There is a need for more relevant and genuine research rather than sheer numbers. This is also the case when it comes to selecting research scholars. A large number of resources are spent in grooming a researcher and the resources must be utilised in the correct manner. Ironically, researchers have not yet identified a tool to identify and evaluate research aptitude.

The objective of the current study was to arrive at a basic instrument to evaluate the research aptitude of an individual. The researchers chose

to follow the DeVellis method for scale development DeVellis (2016). Based on the review of literature and discussions with experts, the researchers of the current study identified a pool of items that would help in measuring research aptitude. These items were then validated by a language expert and eight area experts. The experts were chosen based on their experience in training researchers and their experience in the field of academic research. Following the advice of the experts, the number of items was reduced and the language expert guided the phrasing of the statements.

The initial instrument comprised of 22 items. The item analysis revealed that one statement was not significantly correlated to the total score. Thus, the item was removed and the instrument contained 21 items. The instrument showed strong reliability with a Cronbach alpha score of 0.846. The Exploratory Factor Analysis revealed that the statements loaded on to the relevant dimensions. The dimensions were identified as Achievement Orientation, Task Orientation, Curiosity and Analytical Ability. The identification of the dimensions was done by analysing the statements that were included in each dimension and matching the statements to known competencies in literature. The dimensions have been shown in Figure 2.

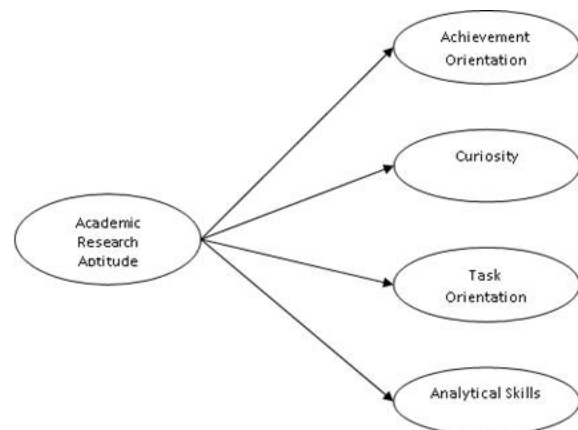


Fig.2: Dimensions of Academic Research Aptitude Scale

The first dimension was achievement orientation. This dimension contained statements that reflected the individual's attitude towards

feedback, belief with regards to completion and creation of quality work, openness to information, ethical and empathetic behaviour. The statements cover the dimensions of personal attitudes and professional ethics, roles and dissemination. The statements were found to fit the definition of achievement orientation as given by Goleman, Boyatzis, Davidson & Druskat, (2017). The definition stressed the need to aim for excellence, seek feedback and aim for continuous learning. This is reflected in items such as “I am open to new information”, “I am comfortable receiving feedback” and “I believe in going the extra mile”. Additionally, Dweck and Leggett, (1988) believed that it is also related to the ability of an individual to understand and react to situations appropriately. This is also reflected in the inclusion of achievement orientation as a dimension of emotional intelligence. The items of the scale “I believe in having flexibility in my plans”, “I believe in giving credit when deserved”, “I take care to consider others' feelings” and “I am excited at the prospect of sharing my knowledge” would reflect the individual's ability to comprehend and react to tasks and situations.

The second dimension is that of curiosity. The term may reflect the emotion or behaviour of being curious with regards to the desire to gain knowledge or learn. Zuss (2012) stressed the need for curiosity to drive any development or learning-related behaviour. The statements of the dimension include “When I learn something new, I am keen to find out more”, reflecting a thirst for knowledge. Additionally, statements such as “I am comfortable with raising questions” and “I don't accept information without justification” would suggest the presence of the scientific mindset, which is expected to support learning and the search for knowledge (Montessori, 2013). In addition, the statements also suggest a level of comfort with asking questions and not accepting anything without a proper source or citation; a skill especially critical for those looking to build and create knowledge.

The third dimension in the scale was task

orientation. Statements in this dimension included “I always get tasks done on time”, “I don't allow my biases to cloud my judgement”, “I believe in setting my own timelines” and “I do not allow setbacks to bother me”. These are meant to measure the individual's level of focus on the task at hand. The definition of task management suggests that task orientation would ensure the creation of plans and structures aimed at the completion of tasks (Ebert, Griffin and Stark, 2011). Task orientation becomes significant in research, as the researcher attempts to keep aside personal judgements and setbacks to adhere to timelines. This would ensure the timely completion of projects and derivation of findings and solutions to current problems. The timeliness of the research is the key to determining the validity and value of the findings. Additionally, the ability to persevere even in the face of setbacks would allow a researcher to face obstacles in the course of the project and prevent feelings of dejection on encountering dead ends.

The last dimension in the scale measures the analytical ability of the researcher. According to Doyle (2019) analytical skills is the ability to collect, analyse and interpret information. These capabilities are reflected in the statements “I enjoy tasks that require in-depth analysis”, “I enjoy finding patterns” and “I enjoy working with numbers”. As discussed earlier, the pervasive adoption of technology has made information easily available, researchers must be able to understand and identify information that is relevant, reliable and appropriate. While the dimension has been termed as analytical ability, the statements measure the researchers' attitude towards analytical tasks. The terming has been done to allow for ease of usage and must not be mistaken with analytical skills such as conducting statistical analysis, which would fall into the category of research skills that can be trained (Rumman, 2019).

The identified dimensions are related to inherent or natural skills. This is a reflection of the proposed definition of research competency, i.e., an individual's ability and interest to participate in

research activities. While the current version shows high reliability, the scale would require constant review and modifications to remain relevant. Just as the field of academic research is constantly changing, the scale would also have to be constantly reviewed and modified based on context, sample and usage. The current version provides a starting point on which to build on.

As the researchers set out on the task of creating the scale, the dearth of research articles on researcher aptitude became apparent. The researchers then had to review websites that explained researcher skills and competencies and relate them to key constructs in Psychology. As the number of researchers continues to rise and more and more applications are received for research-based programs, the current scale is intended to help organizations identify the right individuals. This would allow for more efficient use of resources and the selection of worthwhile candidates who would contribute to the advancement of their respective fields through honest and genuine research in the area.

Conclusion

The objective of the current study was to design a scale that would measure an individual's aptitude for research. This would then enable faster and more accurate identification of persons more suitable for research work and also assist in the identification of areas of development and planning of developmental activities. The items for the scale were arrived at through brainstorming sessions and were validated through a review of the literature and expert opinions. The final list of 21 items was found to represent four major dimensions which the researchers related to achievement orientation, analytical ability, curiosity and task orientation. This identification was achieved through a systematic review of the literature. Although the scale was found to have high reliability and validity, the researchers believe that continuous review and updating of the scale is essential for ensuring the relevance of the scale.

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