



Evaluation of Validity and Reliability of ... Najib, A. (2026)

Evaluation of Validity and Reliability of Pre-Service Geography Teachers' Grit Questionnaire among Colleges of Education in Northwest, Nigeria

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Abstract

This study examined the validity and reliability of the pre-service geography teachers' grit questionnaire (PGTGQ) in Colleges of Education in Northwest Nigeria. A survey research design was adopted and a standard procedure for face, content, and construct validation and reliability testing were followed. Content validity was established through ten (10) experts from geography education, science education, psychology, and test and measurement. The instrument was pilot-tested with a sample of pre-service Geography teachers, and the data were analysed using Cronbach's alpha to assess internal consistency of the instrument. The findings revealed that the Average Expert-Level Face Validity Index (AELFVI) was 0.86, confirming that the questionnaire items were clear and appropriate for measuring pre-service Geography teachers' Grit. A Scale Content Validity Index (S-CVI/Ave) of 0.89 further confirmed that the instrument adequately represented the intended construct. Principal Component Analysis (PCA) showed that ten (10) items with factor loadings greater than 0.40 were retained. The overall reliability coefficient obtained was 0.83, indicating that the instrument was reliable for data collection. Based on these findings, the study concluded that the instrument is valid and reliable to measure the pre-service geography teachers' grit questionnaire in Colleges of Education in Northwest Nigeria and recommended that the PGTGQ can be used to assess pre-service Geography teachers' grit.

Keywords: Grit, Validity, and Reliability.

Introduction

Grit is a non-cognitive attributes that have gained prominence in educational research due to their influence on academic achievement. Grit is defined as passion and perseverance for long-term goals, and it plays a crucial role in academic success by enabling individuals to overcome challenges (Duckworth et al., 2007). In teacher education, grit is particularly important because pre-service teachers must sustain effort in mastering subject matter, pedagogical skills, and teaching practice despite institutional and contextual challenges. Although grit has been widely examined by most of the researchers but most of the measurement instruments were developed and validated in Western contexts (Duckworth & Quinn, 2009). The direct application of such instruments in Nigerian Colleges of Education raises concerns about cultural relevance and psychometric adequacy. Measurement theory emphasizes that instruments must demonstrate acceptable validity and reliability within the population of interest before meaningful interpretation is possible (AERA, APA, & NCME, 2014). Research shows that grit significantly impacts academic achievement across various subjects, though little attention has been paid to pre-service Geography teachers in Northwest Nigerian colleges of education. For instant, Kelly and Zhou (2018) found a strong link between grit and academic achievement, while Doris et al., (2020) confirmed that grit positively affects student performance. Anthony et al., (2020) also found that grit significantly predicts academic achievement. Tugabirwe and Aloysius (2023) revealed a strong association between grit and students' academic performance. Fernandez-Martín et al., (2020) suggested that grit predicts academic achievement. Since researches indicates a positive correlation between grit and academic achievement across disciplines, there is a need to adopted, validated, and find a reliability coefficient of grit questionnaire



Evaluation of Validity and Reliability of ... Najib, A. (2026)

among pre-service Geography teachers' at colleges of education in Northwest Nigeria which remains understudied. This study aims to fill this gap by examining the validity, and reliability of grit questionnaire for pre-service Geography teachers' using both face, content, construct validity, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA), alongside reliability indices such as Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE).

Statement of the Problem

Science education research often involves the adoption of existing, or the development of new instruments to measure phenomena of interest (Taber, 2018). The use of poorly validated instruments may result in inconsistent measurements and inaccurate interpretations of findings (Creswell & Creswell, 2018). Despite increasing interest in grit within educational research, there are inadequate empirically validated grit instruments for pre-service Geography teachers' in Nigerian Colleges of Education. Existing studies have often relied on imported scales without subjecting them to rigorous psychometric evaluation, particularly using advanced techniques such as EFA and CFA. Many studies have focused on the development and validation of questionnaires, but limited attention has been given specifically to the grit of pre-service geography teachers'. For example, Duckworth and Quinn (2009) Developed and validated the Short Grit Scale. Bolaji et al. (2020) developed and validated a geography attitudinal scale, while Gurjiya and Danladi (2024) assessed the validity and reliability of a Geography Interest Questionnaire among pre-service teachers in colleges of education in Northwest Nigeria. Similarly, Abdullahi and Danladi (2025) Assess the Validity and Reliability of Pre-Service Geography Teachers' Attitude Questionnaire in Colleges of Education in North-West, Nigeria. Abdullahi and Danladi (2025) Developed and Validation of a Perception Questionnaire for Pre-Service Geography Teachers. However, there is a need to establish the validity and reliability of a Pre-service Geography Teachers' grit Questionnaire to ensure accurate measurement and to strengthen empirical research in geography education within colleges of education.

Objectives of the Study

The main objective of this study was to establish the validity and reliability of grit questionnaire for pre-service Geography teachers in Northwest Colleges of Education in Nigeria. The Specific objectives are to:

1. Find out the face validity of the pre-service Geography teachers' grit questionnaire in colleges of education in north-west, Nigeria.
2. Determine the content validity of the pre-service Geography teachers' grit questionnaire in colleges of education in north-west, Nigeria.
3. Examine the construct validity of the of the pre-service Geography teachers' grit questionnaire in colleges of education in north-west, Nigeria.
4. Assess the reliability (internal consistency) of the pre-service Geography teachers' grit questionnaire in colleges of education in north-west, Nigeria.

Research Questions

This study is guided by the following research questions:

1. What is the face validity of the pre-service Geography teachers' grit questionnaire in colleges of education in north-west, Nigeria?
2. To what extent does the pre-service Geography teachers' grit questionnaire demonstrate content validity in colleges of education in north-west, Nigeria?
3. What is the construct validity of the pre-service Geography teachers' grit questionnaire in colleges of education in north-west, Nigeria?



Evaluation of Validity and Reliability of ... Najib, A. (2026)

4. What is the reliability coefficient of the pre-service Geography teachers' grit questionnaire in colleges of education in north-west, Nigeria?

Methodology

A survey research design was adopted to examine pre-service geography teachers' attitudes toward geography. The survey research design was considered appropriate because it enables the researchers to collect personal and social facts, beliefs, and attitudes of respondents (Oloyede et al., 2011). Another reason for adopting this method is that it involves gathering information or data from a large population by studying a representative sample of the entire group (Abdullahi et al., 2008). The participants comprised pre-service geography teachers from colleges of education in the Northwest Zone of Nigeria. Two (2) colleges of education participated in the study, and a total of two hundred (200) pre-service geography teachers were selected. To assess the grit levels of pre-service Geography teachers' the researcher adapted the Grit Scale originally developed by Duckworth and Quinn (2009), with permission. The instrument assesses two core components of grit: consistency of interest and perseverance of effort. The original response format of the scale are: 5 (Very much like me), 4 (Mostly like me), 3 (Somewhat like me), 2 (Not much like me), and 1 (Not like me at all) was modified by the researcher to a five-point Likert scale: 5 (Strongly Agree), 4 (Agree), 3 (Undecided), 2 (Disagree), and 1 (Strongly Disagree). The questionnaire is divided into two sections. Section A collects demographic information such as age, academic level, admission number, and name of the college. Section B measures the grit of pre-service Geography teachers. Items 1–5 assess consistency of interest, while Items 6–10 assess perseverance of effort. To establish the face and content validity of the Pre-service Geography Teacher Attitude Questionnaire, ten (10) academic professionals, ranging in rank from Senior Lecturers to Professors, were selected from the Department of Science Education at Bayero University Kano, the Federal University of Technology Minna, Sule Lamido University Kafin Hausa, and the Department of Geography at Sa'adatu Rimi College of Education, Kano. The experts specialize in Geography Education, Science Education, Psychology, and Statistics, were asked to review the instrument at their convenience. The experts were provided with the questionnaire and a validator's report form for scoring the instrument. They were requested to assess the instrument based on the simplicity of language, clarity of items, and appropriateness and adequacy for the target population. Their observations, comments, corrections, and suggestions made during the validation process were incorporated into the final version of the questionnaire. To determine construct validity, the Pre-service Geography Teacher Grit Questionnaire, Exploratory Factor Analysis (EFA), and Confirmatory Factor Analysis (CFA) were conducted in SPSS Version 27.0 and SPSS AMOS Version 25. The Exploratory Factor Analysis (EFA), Principal Component Analysis (PCA) was used to assess data suitability using the Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity, and PCA factor loadings from the Promax Rotation Method with Kaiser Normalization. To establish the reliability of the Pre-service Geography Teachers' Grit questionnaire (PGTAQ), a pilot test was conducted involving 30 pre-service Geography teachers from a public College of Education in the Northwest. The reliability coefficient for the PGTGQ was determined using Cronbach's alpha.

Presentation of Results

Research Questions One: - What is the face validity of the pre-service Geography teachers' Grit questionnaire in colleges of education in north-west, Nigeria?

Table 1: Face Validity Index of Pre-service Geography Teachers Grit Questionnaire

Expert	CI (30%)	AP (30%)	A (40%)	E-LVI
1.	25	27	34	86
2.	24	29	37	90
3.	28	28	34	90



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Evaluation of Validity and Reliability of ... Najib, A. (2026)

4.	23	26	36	85
5.	26	25	35	86
6.	27	25	36	88
7.	24	27	32	83
8.	29	25	33	87
9.	28	26	34	88
10.	22	24	35	81

AELFVI

864/10= 86.4

Key: CI: Clarity of Instructions, AP: Appropriate for the participant, A: Adequate E-LVI: Experts Logical Validity Index AELFVI: Average Expert Face Logical Validity Index

Table 1 presents the results of the face validity index of the Pre-service Geography Teachers' Grit Questionnaire. The Average Expert-Level Face Validity Index (AELFVI), calculated from the ratings of ten experts, was 86.4, confirming that the instrument is suitable for pilot testing and full-scale data collection as recommended by Desai and Patel (2020). This indicates that the experts agreed that the questionnaire items are clear, appropriate for measuring pre-service geography teachers' Grit, and sufficiently comprehensive in covering the construct of grit.

Research Questions Two: - To what extent does the pre-service Geography teachers' Grit questionnaire demonstrate content validity in colleges of education in north-west, Nigeria?

Table 2: Content validity index of Pre-service Geography Teachers Grit Questionnaire

Items	E 1	E 2	E 3	E 4	E 5	E 6	E 7	E 8	E 9	E 10	E in A	I-CVI	Decision
1.	1	1	1	1	1	1	0	1	1	1	9	0.9	Retain
2.	1	0	1	1	1	1	1	1	1	1	9	0.9	Retain
3.	1	1	1	1	1	1	0	1	1	1	9	0.9	Retain
4.	1	0	1	1	0	1	1	1	1	1	8	0.8	Retain
5.	1	1	1	1	1	1	0	1	1	1	9	0.9	Retain
6.	1	1	0	1	0	1	1	1	1	1	8	0.8	Retain
7.	1	1	1	1	1	1	1	0	1	1	9	0.9	Retain
8.	1	0	1	1	1	1	1	1	1	1	9	0.9	Retain
9.	1	1	1	1	1	1	0	1	1	1	9	0.9	Retain
10.	1	1	1	1	1	1	1	1	1	1	10	1.0	Retain
S-CVI/Ave												0.89	

Key: E= expert, E in A= Expert in agreement, I-CVI= Item content validity index

Table 2 presents the results of the content validity index analysis of the Pre-service Geography Teachers' Grit Questionnaire. The findings indicate that all ten (10) items achieved acceptable Item Content Validity Index (I-CVI) values, ranging from 0.90 to 1.00. Consequently, all items were retained. At the scale level, a Scale Content Validity Index based on the average method (S-CVI/Ave) of 0.89 was obtained, confirming that the instrument adequately represents the construct of pre-service geography teachers' grit.

Research Questions Three: - What is the construct validity of the pre-service Geography teachers' grit questionnaire in colleges of education in north-west, Nigeria?

Table 3: Kaiser-Meyer-Olkin Measure of Sampling Adequacy and Bartlett's Test of Sphericity of Pre-service Geography Teacher Grit Questionnaire

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.875
Bartlett's Test of Sphericity	Approx. Chi-Square	5115.067
	Df	66
	Sig.	.000

Evaluation of Validity and Reliability of ... Najib, A. (2026)

The table 3 presents the result of Kaiser-Meyer-Olkin Measure of Sampling Adequacy and Bartlett's Test of Sphericity Result. The analysis revealed that the sample used for this study was adequate, with a KMO value of 0.875, $df = 66$, and $p = 0.000$. These results indicate that the data were suitable for factor analysis and could be used to determine the construct validity of the instrument using SPSS AMOS. To identify the items to be retained in the questionnaire, Principal Component Analysis (PCA) with the promax rotation method was employed. The results of this analysis are presented in table 4.

Table 4: Principal Component Analysis Factor Loading for Pre-service Geography Teacher Grit Questionnaire

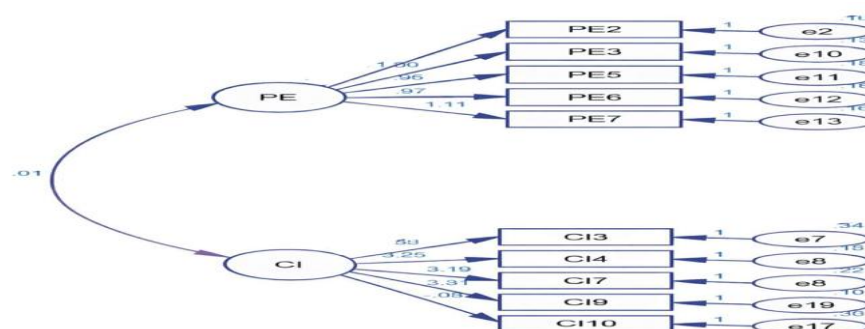
Pattern Matrix ^a		Component	
Items		1	2
CI1	I stay focused on Geography projects until I complete them.	.992	
CI2	I remain committed to my previous Geography ideas even when new ones come up	.963	
CI3	I maintain my focus and interest in Geography-related tasks over time.	.823	
CI4	My interest in Geography remains strong and does not change easily.	.981	
CI5	I stay passionate about Geography ideas and projects for a long time.	.976	
PE1	I keep trying to understand Geography even when I face difficulties.		1.000
PE2	I work hard and remain committed to mastering Geography.		1.000
PE3	I complete whatever I begin in Geography.		1.000
PE4	I never give up on learning Geography, no matter the challenges.		1.000
PE5	I overcome setbacks and continue working hard to achieve success in Geography.		1.000

Key: PE: perseverance of Effort, CI: Consistency of Interest

Table 4 presents the result of the Principal Component Analysis Factor Loading for the Pre-service Geography Teacher Attitude Questionnaire. As recommended by Hair, Black, Babin & Anderson (2014), who suggested that an instrument with good construct validity should have loading values between ± 0.30 and above, this study considers and uses an instrument with good construct validity; therefore, ten (10) items with a loading factor greater than 0.40 are selected.

Confirmatory Factor Analysis of Pre-service Geography Teachers' Grit Questionnaire (PGTGQ)

The items loaded from the exploratory factor analysis are confirmed using confirmatory factor analysis in SPSS AMOS Version 25.0. Fit indices, including the ratio of chi-square to its degrees of freedom (χ^2/DF ratio), the goodness-of-fit index (GFI), the adjusted goodness-of-fit index (AGFI), the Tucker-Lewis index (TLI), the comparative fit index (CFI), and the root mean square error of approximation (RMSEA), were used to determine the model fit. The model is presented in Figure 1.





Evaluation of Validity and Reliability of ... Najib, A. (2026)

Figure 1: Confirmatory Factor Analysis Model of Pre-service Geography Teachers' Grit Questionnaire (PGTGQ). Key: CI: Consistency of Interest, PE: Perseverance of Effort

Figure 1 presents the CFA model of PGTGQ; the fit indices for the model fall within the acceptable range after deleting unloaded and cross-loaded items. Hence, the model fit and ten (10) items are appropriate, valid, and therefore form the items for the final copy of the instrument.

Convergent Validity of Pre-service Geography Teachers' Grit Questionnaire (PGTGQ)

To establish the convergent validity of the PGTGQ, Composite Reliability (CR) and the Average Variance Extracted (AVE) were used. Hair et al., (2019) recommended that convergent validity of the construct is achieved when the average variance extracted (AVE) is ≥ 0.50 and composite reliability (CR) value falls within the range of ≥ 0.70 . The result was calculated using Excel Tools, and the result is presented in Table 5.

Table 5: Composite Reliability (CR) and Average Variance Extracted (AVE) Value and Square Root of (AVE) for U, D, and RE and Inter-Factor Correlation of Pre-service Geography Teachers' Grit Questionnaire (PGTGQ)

Factor	CR	AVE	CI	PE
CI	0.782	0.750	0.866	
PE	0.822	0.682	0.254	0.825

Table 5 presents the Composite Reliability (CR) and Average Variance Extracted (AVE) values for PGTGQ. The analysis revealed that CI and PE had CRs of 0.782 and 0.822, respectively, which are > 0.7 , indicating that the constructs are reliable. However, the table also shows the AVE values for CI and PE to be 0.750 and 0.682, respectively, which exceed the acceptance value of 0.50, indicating that all three constructs explain over 50% of the variance in the items that comprise them. Therefore, with these CR and AVE values, the convergent validity of PGTGQ is established, and it is concluded that individual items for each construct converged in comparison to items measuring another construct to measure that particular construct.

Discriminant Validity of Pre-service Geography Teachers' Grit Questionnaire (PGTGQ)

To establish the discriminant validity of the PGTGQ, the Fornell-Larcker criterion was used. Fornell-Larcker (1981) suggested that the square root of the AVE value is compared with the inter-factor correlation, and the inter-factor correlation should be less than the square root of the AVE. The analysis was conducted using Excel Tools, and the results are presented in Table 5. Table also presents the Square Root of Average Variance Extracted (AVE) for CI and PE. The bolded diagonal values are the square roots of the AVEs, and the other values are inter-construct correlations. The requirement is that the diagonal values should be greater than the other values in their respective rows and columns, which is met, as shown in the table. It was therefore concluded that both constructs (CI and PE) empirically distinguish themselves from each other in the PGTGQ and are affirmed to have good discriminant validity.

Research Questions Four: - What is the reliability coefficient of the pre-service Geography teachers' grit questionnaire in colleges of education in north-west, Nigeria?

Table 6: Reliability of Pre-service Geography Teachers' Grit Questionnaire (PGTGQ)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.836	.734	10

Table 6 present the reliability coefficient for the PGTGQ, The internal consistency of the questionnaire items yielded a Cronbach's alpha of 0.83, indicating high reliability.



Evaluation of Validity and Reliability of ... Najib, A. (2026)

Discussion of Findings

The findings from Research Question One show that a Face Validity Index of 86.4% was obtained. This result is in line with that of Desai and Patel (2020), who stated that an instrument with a face validity index of 80% to 100% is considered to have full face validity. The findings from Research Question Two indicate that all 10 items achieved acceptable Item Content Validity Index (I-CVI) values, ranging from 0.80 to 1.00. Consequently, all items were retained, and a Scale Content Validity Index based on the average method (S-CVI/Ave) of 0.89 was obtained. This finding agrees with Yusoff (2019), who recommended that acceptable cut-off scores for the CVI should be 0.78 or higher when at least nine experts are involved. Accordingly, this study adopted a cut-off score of 0.78 or above for the content validity index, based on evaluations from ten experts. The findings from Research Question three shows that ten (10) items with factor loadings greater than 0.40 were selected and used in the final instrument. This result is consistent with the recommendation of Hair et al., (2014), who suggested that instruments with good construct validity should have factor loadings of ± 0.30 or higher. Based on this criterion, ten (10) items with factor loadings exceeding 0.40 were retained. The findings from Research Question Four indicate that the questionnaire's internal consistency yielded a Cronbach's alpha coefficient of 0.83, indicating high reliability. This finding aligns with Gay et al. (2009), who stated that instruments with Cronbach's alpha values between 0.80 and 0.90 are considered highly reliable.

Conclusion

This study determines the validity and reliability of pre-service Geography teachers' grit questionnaire in Colleges of Education in Northwest Nigeria. The findings of the study provide a comprehensive understanding on how to validate and find a reliability of the grit questionnaire. Based on the results, the following conclusions were made, the instrument demonstrate a good and acceptable Face Validity Index of 86.4%, all the ten (10) items achieved acceptable Item Content Validity Index (I-CVI) values, ranging from 0.80 to 1.00 and a Scale Content Validity Index based on the average method (S-CVI/Ave) of 0.89 was obtained. The result shows that ten (10) items with factor loadings greater than 0.40 were selected and used in the final instrument and the internal consistency yielded a Cronbach's alpha coefficient of 0.83, indicating high reliability. Lastly, the study concluded that the instrument is valid and reliable to measure the pre-service geography teachers' grit at Colleges of Education in Northwest Nigeria

Recommendations

Based on these findings, it is recommended that:

1. The instrument is valid and reliable to measure the pre-service geography teachers' grit.
2. The questionnaire can be refined and revalidated in different cultural or institutional settings to enhance its broader applicability.
3. Researchers, Education stakeholders and teacher educators may use the instrument to measure pre-service geography teachers'.

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Evaluation of Validity and Reliability of ... Najib, A. (2026)

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