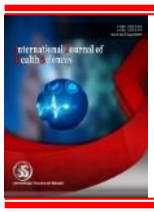

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Factor Analysis of Research Culture: A Comparative Study of 3-Point and 5-Point Likert Scales

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Abstract

Understanding factors that foster a strong research culture requires a reliable measurement tool. The 3-point and 5-point Likert scales are widely used in surveys to gauge attitudes. However, the choice between these scales may influence data quality, reliability, and interpretation, potentially affecting the actor's analysis. Despite its widespread use, there is limited research comparing the scales' dimensionality, model fit, and validity in contributing to research culture assessments. Thus, the study aims to compare the effectiveness of 3-point and 5-point Likert scales using confirmatory factor analysis (CFA). This descriptive-comparative study was conducted among 1,139 allied health students in selected sectarian institutions in the Philippines, using purposive and random sampling techniques. The respondents completed a self-constructed research culture questionnaire. Data analysis using SPSS and AMOS confirmed three factors: *motivation, attitude, and competence in research* with CFA indicating a *good fit*. But the 5-point Likert scale has *better reliability and validity results;* it showed *higher* composite reliability, *better* average variance extracted (AVE) coefficients, and *better* construct validity using the Fornell-Larcker criterion, while the 3-point has a *better fit* using the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). Both the 3- and 5-point scales have their strengths and weaknesses. It is recommended for further study to expand the sample size with respondents from different age groups.

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1 Introduction

Students in universities are given the knowledge, abilities, and other competencies required for conducting independent research. However, developing the requisite skills and knowledge is only one factor that affects one's capacity to conduct research; the affective domain also has a big impact on this process (Kakupa & Xue, 2019). Despite possessing pertinent research expertise, a person's anxiousness and negativity about conducting research might negatively affect the entire process (Canti et al., 2021; Kakupa & Xue, 2019). Numerous studies have highlighted the critical significance of the affective component in student learning (Kakupa & Hue, 2019). According to Kakupa & Hue (2019), to develop techniques for promoting or maintaining favorable research attitudes, it is therefore deemed vital to analyze these attitudes. Researchers investigating attributes from the affective domain frequently confront more hurdles than those studying traits from the cognitive domain (Sözer & Kahraman, 2021). It appears that knowledge and research skills alone are insufficient for conducting research. The affective component is crucial in the creation of research.

Surveys frequently employ the 3-point and 5-point Likert scales to measure respondents' attitudes (Sözer & Kahraman, 2021; Polit & Beck, 2008) that each indicate a position on a certain subject (Polit & Beck, 2008). The degree to which respondents usually agree on positively stated statements or disagree with the negatively stated items (Sözer & Kahraman, 2021; Polit & Beck, 2008). The selection of these scales, however, may have an impact on the factor analysis by influencing the interpretation, reliability, validity, and quality of the data (Sözer & Kahraman, 2021). It is crucial to understand the distinctive features of a test's constructs before conducting a thorough validation of an instrument or educational tool (Cappelleri et al., 2014). As a result, a lot of research has been done to look at the dimensionality of test structures. Test dimensionality is the number of latent variables or constructs that a test measure (Paek & Cole, 2019; Mellenbergh, 2019; Irwing et al., 2018). A multidimensional test measures more than one latent variable or variable item intercorrelations, whereas an important unidimensional test primarily assesses one latent variable or highly intercorrelated variable (Mellenbergh, 2019; Kean et al., 2018). The most used method for evaluating dimensionality is factor analysis (Paek & Cole, 2019; Mellenbergh, 2019; Kean et al., 2018; Zanon et al., 2016).

Factor analysis is a statistical method employed to discern interrelationships among items and categorize them into homogeneous domains, constructs, or factors (Finch, 2020). It is frequently utilized in questionnaire construction to minimize the number of items and delineate domains. The primary methodologies are exploratory factor analysis (EFA), which reveals latent structures (Coker et al., 2018), and confirmatory factor analysis (CFA), which evaluates the structures suggested (Canivez et al., 2019). The procedure encompasses multiple stages, such as evaluating correlation matrices, extracting factors, and factor rotation. Recently, researchers have investigated the utilization of model fit indicators often used in confirmatory factor analysis (CFA) to determine the appropriate number of constructs to retain (Finch, 2020; Clark & Bowles, 2018; Garrido et al., 2016; Preacher et al., 2013). The CFA enables researchers to test the compatibility of a theoretical model with the data by employing several fit indices to determine model adequacy. It establishes the platform for tackling concerns with measurement validity and reliability (Finch, 2020).

Assessing the model's relative fit using its information criterion is one technique to decide which model to fit. When the model explained the data as a whole effectively, it is known as model fit (De Ayala, 2022; Bryne, 2013). Model fit is not anticipated to be perfect when a model is overidentified; thus, it is important to assess the actual level of model fit, and the fit statistics show that the models fit the data well or are statistically

acceptable (De Ayala, 2022; Bryne, 2013; Kline, 2023). Modification indices are used to evaluate and detect local dependency (Clark & Bowles, 2018). The following are the goodness of fit indices: chi-square value, CMIN/DF, or minimum discrepancy divided by the degrees of freedom, Root Mean Squared Error Approximation (RMSEA), Root Mean Square Residual (RMR), Comparative Fit Index (CFI), Tucker- Lewis Index (TLI), Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) (Shi et al., 2022; Moss et al., 2015). Model validity is one of the tools used to also evaluate the model fit of the data. Principal component analysis (PCA) can be used to estimate if the data fits the model. The components of PCA are composite reliability (CR) using Cronbach's alpha, average variance extracted (AVE) for convergent validity, and maximum variance (MSV) and Fornell and Larcker criterion to evaluate discriminant validity (Hair Jr. et al., 2021; Gefen et al., 2020 as cited in Alumran et al., 2014).

Factor analysis is widely used in test construction and validation. Despite its widespread use, there is limited comparative research on how the scale type impacts the dimensionality, model fit, and validity contributing to research culture. Thus, the study seeks to address this gap by comparing the effectiveness of 3-point and 5-point Likert scales using confirmatory factor analysis.

2 Materials and Methods

This validity study used quantitative research design, specifically descriptive-comparative and survey research designs. A descriptive-comparative study was used in this study to determine the dimensionality, model fit, and validity of the 3-point and 5-point Likert scales of research culture. The sampling techniques used in selecting the participants are purposive and random sampling techniques. The sampling frame consisted of 1,151 allied health undergraduate students in the six private sectarian institutions in the Philippines. However, 1,139 were deemed valid for analysis; 12 responses were excluded due to incomplete data and inconsistencies. The participants included allied health undergraduate students who were enrolled in research class during the academic year 2023-2024 and under research writing with or without statistics in their curriculum.

Participants who were qualified to be part of the study were grouped into two according to their class section. One group took the 3-point Likert scale and the other group the 5-point Likert scale of the research culture questionnaires. Random sampling was used to assign the group. The researcher utilized 2 groups of respondents to answer the 3-point scale and 5-point scale rather than using one group to answer both because the researcher considered the cognitive burden that youngsters might feel answering a very long questionnaire. This might also affect the result of the study if they are burdened with answering a very long questionnaire.

Physical copies were given. The researcher subsequently explained the purpose of the study and its objectives. Prior to answering the survey questionnaires, the researcher explained the ethical considerations for participants' privacy and confidentiality. The key informants were provided with a comprehensive explanation of the study's goal, and the participants were given a clear and detailed explanation of the informed consent before they completed the questionnaire. The researchers kept the identities of the individuals hidden. The key informants were thoroughly briefed on the strict confidentiality of the study's findings and were granted the prerogative to withdraw their involvement at any point during the research (Van Nunen et al., 2018).

Instrumentation

The instrument is a self-constructed questionnaire. The research culture scale was created to get an overview of the allied health students' research culture. There are few quantitative tools that approach the study of research formation, specifically through the research culture method among allied health undergraduate students. The questionnaire was developed using a review of literature from various approaches.

In terms of the study of research culture, the questionnaire regarding the role of research in establishing research culture among the health information management in the hospital with regard to their perceptions on research, their research activities, and the barriers and enablers to conduct research (Kemp et al., 2020); and the Research Capacity and Culture (RCC) tool was used by Matus et al. (2020), to measure the perceived

research capacity and culture of allied health professionals, which describe strengths, barriers, and motivators to undertaking research within the individual, team, and organizational level. Alternatively, Marrs et al. (2022), evaluated the research culture of PhD program graduates using the Research Competence (R-Comp) scale, which includes dimensions of knowledge and practices to research. The questionnaire on the roles of research in teaching was another strategy for examining research culture. It asked instructors about the ideal role of research in instruction as well as their perceptions of the actual role of research in their own teaching (Hu et al., 2014). Furthermore, four instruments were used to analyze the research culture from the perspective of attitude toward research: the questionnaire about undergraduate students' attitudes toward research (Barrios & Ulises, 2020), the Nursing Research Questionnaire (NRQ), Nurses' Attitudes Toward and Awareness of Research and Development in Nursing (NATARD) (Nilsson Kajermo et al., 2014), and Research Culture (Res-Cul) (Coronel-Santos & Ramírez-Montoya, 2020).

Finally, two questionnaires were used to investigate the research culture from the perspective of motivation toward research. The first instrument is the Teacher Research Motivation Scale (TRMS), which was used by Hosseini & Bahrami (2022), to evaluate the research motivation of language teachers, which includes intrinsic research motivation, extrinsic research motivation, and research failure avoidance. The second instrument is the Research Motivation Scale for Peruvian University Students (MoINV-U), which measured the willingness and interest of the students to participate in research activities (Esteban et al., 2022).

To ensure the content and face validity of the instrument, seven experts in research and questionnaire development and four allied health students were invited to assess each item of the scale based on the relevance of the item content to allied health research culture. To assess content validity, which measures the extent to which the items in a study cover the construct being examined, a series of actions were undertaken throughout the design phase. Initially, it was formed through a meticulous examination of the pertinent literature. Subsequently, experts in the field examined the questionnaire, provided recommendations, and enumerated the rationale behind their revisions of items. A table of specifications was also made to make sure that all topics in the research were covered. Then, face validity was done by reviewing the questionnaire design. Modifications were made according to experts' opinions.

Data Analysis

After gathering all the data, the research culture scale was established by using Statistical Package for Social Sciences Software (SPSS) and Analysis of Moment Structures (AMOS). The SPSS was used to find out the dimensionality assumption on a 3-point scale and a 5-point scale, while AMOS was used to confirm the model fit and model validity of the scales through Confirmatory Factor Analysis (CFA).

A structural equation model was built with the factors for a 3-point and 5-point Likert items of the research culture scale. Modification indices were evaluated to detect local dependency. The goodness of fit indices were evaluated using chi-square value, CMIN/DF or minimum discrepancy divided by the degrees of freedom, Root Mean Squared Error Approximation (RMSEA), Root Mean Square Residual (RMR), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Akaike Information Criterion (AIC) and Bayesian Information criterion (BIC).

Model validity measures of 3-point and 5-point Likert items of the research culture scale were also evaluated using the principal component analysis (PCA). The PCA was used to measure composite reliability (CR) using Cronbach's alpha, average variance extracted (AVE) for convergent validity, and maximum variance (MSV) and the Fornell-Larcker criterion to evaluate discriminant validity (Hair Jr. et al., 2021; Gefen et al., 2020, as cited in Alumran et al., 2014).

3 Results and Discussions

The number of unique categories or factors that a scale measures are referred to as its dimensionality (Paek & Cole, 2019). Test dimensionality is the number of latent variables or constructs that a test measure (Paek & Cole, 2019; Mellenbergh, 2019; Irwing et al., 2018). The most used method for evaluating dimensionality is factor analysis (Paek & Cole, 2019; Mellenbergh, 2019; Kean et al., 2018). Principal component analysis with

varimax rotation was used to eliminate non-reflective or redundant items and ascertain the number of factors that could account for most of the common variance.

The Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity should be considered first before using factor analysis. KMO is a statistic that tells whether the constructs have sufficient items for each factor and the adequacy of the sample. According to Fouad et al. (2020), if KMO values are near 1.0, it is considered excellent, and if they are below 0.5, it is considered undesirable. Meanwhile, Bartlett's test of sphericity was used to determine whether a correlation matrix and an identity matrix differ significantly (Fouad et al., 2020). Further, this test determines whether there is any redundancy in the variables that may be summed up into a small number of factors. If the p-value of the test is below the significant level (less than 0.05), it demonstrates that there are significant correlations among the variables, rejecting the null hypothesis, thus justifying the use of factor analysis (Shrestha, 2021). The 3-point and 5-point Likert items of the research culture scale were evaluated for factorability of the data.

Table 1 presents the KMO and Bartlett's Test of Sphericity of a 3-point and a 5-point Likert items of research culture scale among allied health students. It reveals that the overall KMO measure for sampling adequacy of the 3-point Likert scale of the research culture scale is .919 (Marvelous) while the 5-point Likert scale has .930 (Marvelous). This proves that factor analysis is appropriate for the data because sampling is sufficient. Moreover, the Bartlett's test of sphericity of the 3-point and 5-point Likert items of research culture is statistically significant (p = < 0.001), which suggests that the variables were significantly correlated. Therefore, this result showed that the data was suitable for factor analysis.

Table 1
KMO and Bartlett's Test of Sphericity of 3-Point and 5-Point Likert Items

KMO and Bartlett's Test		3-point	5-point
KMO Measure of Sampling Adequacy		.919	.930
Bartlett's Test of Sphericity	Approx. chi-square	5545.446	7191.631
	df	276	276
	Sig.	.000	.000

KMO≥ 0.90 = Marvelous, 0.80 ≤ KMO < 0.90 = Meritorious; 0.70 ≤ KMO < 0.80 = Average; 0.60 ≤ KMO < 0.70 = Mediocre; 0.50 ≤ KMO < 0.60 = Terrible; KMO < 0.50 = Unacceptable; Bartlett's Test of Sphericity <0.05 = significant

Dimensionality Profile of 3-point Likert Items

Table 2 shows the eigenvalues and total variance explained by the 3-point Likert items of the research culture scale.

Table 2
Eigenvalues and Total Variance Explained for 3-Point Likert Items

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.224	31.466	31.466	7.24	31.47	31.47	4.99	21.70	21.70
2	2.58	11.220	42.686	2.58	11.22	42.67	3.73	16.19	37.90
3	2.07	8.983	51.669	2.07	8.98	51.67	3.17	13.77	51.67
4	.986	4.285	55.954						
5	.968	4.208	60.162						
6	.847	3.681	63.843						
7	.749	3.258	67.101						
8	.677	2.942	70.043						
9	.618	2.688	72.731						

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
10	.599	2.603	75.334						
11	.565	2.457	77.790						
12	.551	2.394	80.184						
13	.547	2.380	82.564						
14	.506	2.200	84.764						
15	.484	2.104	86.868						
16	.463	2.015	88.883						
17	.449	1.951	90.834						
18	.402	1.748	92.581						
19	.382	1.660	94.242						
20	.363	1.580	95.822						
21	.351	1.527	97.349						
22	.344	1.496	98.845						
23	.266	1.155	100.000						
Extraction Method: Principal Component Analysis.									

The analysis revealed that out of the initial 73 items, a total of 23 linear components were discovered in the dataset. Following extraction and rotation, three different linear components were found within the data set with an eigenvalue of >1.00. These three factors are extracted, explaining a total of 51.67% of the overall variance. It is suggested that the retained factors should be at least 50% of the total variance explained (Tavakol & Wetzel, 2020).

The result indicates that the three factors that account for 51.67% of the common variance are shared by 23 variables. This is the reflection of the KMO value of .919, which can be considered good and indicates that factor analysis is useful for the variables. This initial solution suggests that the final solution will extract not more than three factors. The first component explained has an eigenvalue of 7.24 and explains 21.70% of the total variance. The second component has an eigenvalue if 2.58 and explains 11.22% of the total variance. The third component has an eigenvalue of 2.07 and explains 8.98% of the total variance. The number of factors was also confirmed with the visual inspection of the scree plot, which showed a sudden drop in the scree beginning with the fourth factor as shown in Figure 1.

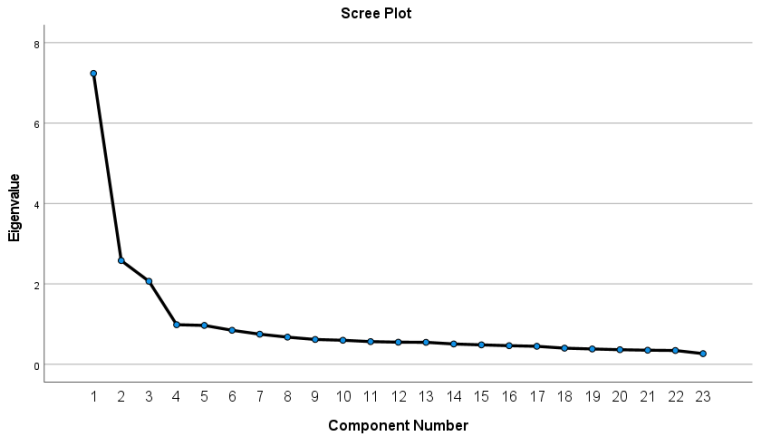

Figure 1. Scree Plot of the Eigenvalues of the Factors for a 3-Point Likert Items

Table 3 depicts the communalities, indicating the proportion of each variable's variance explained by the extracted factors for a 3-point Likert scale. They indicate the extent of common variance in the data structure that is retained following the identification of the factors. Factor loading values denote the degree and direction of the relationship between each variable and the underlying factors, providing an indicator of the alignment of each variable with the factors (Shrestha, 2021).

The result shows that out of the 73 items in the initial survey questionnaire, a total of 23 items remained. This is because the standardized factor loadings that were applied in the study were >0.5. Hair et al. (as cited in Cheung et al., 2023) suggested that the standardized value in factor loading should be at least 0.5 and, ideally, at least 0.7, whereas Steven (as cited in Cheung et al., 2023) argued that 0.4 and above is still acceptable.

Table 3 shows that the 23 items of the 3-point Likert items resulted in three factors. Factor loadings resulted from.600 to .802. Factor 1 included 9 items, labeled as '*Motivation on Research';* Factor 2 has 8 items, labeled as '*Attitude on Research';* and Factor 3 included 7 items, labeled as '*Competence on Research*'. Additionally, it was made sure that every factor had a minimum of three items (Dennis, 2014). Furthermore, in the initial survey questionnaire, the factor motivation has three dimensions, namely intrinsic motivation, extrinsic motivation, and motivation. However, the researcher decided to put them in just one dimension because this was what came out in the confirmatory factor analysis. Furthermore, none of the amotivation items had a factor analysis of 0.5 and above.

Table 3 also shows the communalities that suggest the common variance in the data set for a 3-point Likert scale. The communality value corresponding to the first statement for the factor motivation is.66, indicating that 66% of the variance associated with this statement is common or shared by other variables. Similarly, 62%, 57%, 59%, 50%, 51%, 52%, 53%, and 41% of the common variance are associated with statements one to nine, respectively. For the factor attitude, the first item has a communality value of.60, which means 60% of the variance with this statement is common. The subsequent statements show common variances of 56%, 58%, 49%, 52%, 55%, and 56% for statements one through seven, respectively. While for the factor competence, the first item has.54 communality, reflecting 54% of its variance is common. The common variance for statements one through seven is 46%, 45%, 44%, 42%, 40%, and 42%, respectively.

Table 3
Factor Loadings of Principal Component Analysis After Varimax Rotation of a 3-Point Likert Items

Items (n=23)	Communality after Extraction	Factors 1	2	3
Motivation on Research				
(54) The skills I have acquired in research will be helpful to me in the future.	.66	.802		
(53) I believe that the things I learn in research will be helpful.	.62	.782		
(56) Learning about research stimulates my thinking.	.57	.718		
(55) It gives me great pleasure when I learn something new while conducting research.	.59	.716		
(64) Research will give me opportunities to network with other researchers.	.50	.684		
(63) I believe that research will provide me professional skills.	.51	.682		
(65) Research is useful for my career.	.52	.677		
(67) I believe that getting involved in research will help me better prepare for the career I have chosen.	.53	.655		
(43) Doing research is important.	.41	.629		
Attitude on Research				
(60) I am motivated to publish scientific research.	.60		.746	
(40) I have high level of interest in conducting research.	.56		.731	
(51) I plan to conduct my own research in the future.	.58		.716	
(61) Lately, I have been paying attention to scientific research	.49		.688	

courses.		
(48) I enjoy my research course.	.52	.678
(50) I feel good about myself when I am involved in research.	.55	.631
(52) I find research interesting.	.56	.608
Competence on Research		
(2) I know the different ways to consider of selecting a research topic.	.54	.717
(9) I know how to conduct a comprehensive review of the literature.	.46	.665
(3) I can identify research gaps.	.45	.663
(14) I am familiar with different research designs in my discipline.	.44	.655
(1) I know where to find the topic for research.	.42	.628
(8) I can identify peer-reviewed journal articles.	.40	.605
(13) I can identify the appropriate research design for my research questions.	.42	.600

Dimensionality Profile of 5-point Likert Items

Table 4 shows the eigenvalues and total variance explained of the 5-point Likert items of the research culture scale. The results showed that out of 73 items before extraction, 23 linear components were identified within the data set. Following extraction and rotation, three different linear components were found within the data set with an eigenvalue of >1.00. These three factors are extracted, accounting for a combined 57.73% of the total variance. It is suggested that the retained factors should be at least 50% of the total variance explained (Tavakol & Wetzel, 2020). The result indicates that the three factors account for 57.73% of the common variance shared by 23 variables. This is the reflection of the KMO value,.930, which can be considered good and indicates that factor analysis is useful for the variables. This initial solution suggests that the final solution will extract not more than three factors. The first component explained has an eigenvalue of 8.78 and explains 23.67% of the total variance. The second component has an eigenvalue of 2.65 and explains 18.48% of the total variance. The third component has an eigenvalue of 1.85 and explains 15.58% of the total variance. The number of factors was also confirmed with the visual inspection of the scree plot, which showed a sudden drop in the scree beginning with the fourth factor as shown in Figure 2.

Table 4
Eigenvalues and Total Variance Explained for 5-Point Likert Items

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.78	38.155	38.155	8.78	38.16	38.16	5.44	23.67	23.67
2	2.65	11.535	49.689	2.65	11.54	49.69	4.25	18.48	42.15
3	1.85	8.036	57.725	1.85	8.04	57.73	3.58	15.58	57.73
4	.979	4.259	61.984						
5	.918	3.990	65.974						
6	.783	3.403	69.377						
7	.712	3.095	72.473						
8	.621	2.700	75.173						
9	.605	2.632	77.804						
10	.527	2.290	80.094						
11	.498	2.165	82.259						

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
12	.476	2.070	84.329						
13	.451	1.959	86.288						
14	.417	1.811	88.100						
15	.402	1.749	89.849						
16	.374	1.628	91.477						
17	.355	1.544	93.021						
18	.337	1.463	94.484						
19	.324	1.411	95.895						
20	.273	1.187	97.081						
21	.244	1.060	98.141						
22	.233	1.011	99.152						
23	.195	.848	100.000						
Extraction Method: Principal Component Analysis.									

The results showed that out of 73 items prior to extraction, 23 linear components were identified within the data set. Following extraction and rotation, three different linear components were found within the data set with an eigenvalue of >1.00. These three factors are extracted, accounting for a combined 57.73% of the total variance. It is suggested that the retained factors should be at least 50% of the total variance explained (Tavakol & Wetzel, 2020). The result indicates that the three factors account for 57.73% of the common variance shared by 23 variables. This is the reflection of the KMO value,.930, which can be considered good and indicates that factor analysis is useful for the variables. This initial solution suggests that the final solution will extract not more than three factors. The first component explained has an eigenvalue of 8.78 and explains 23.67% of the total variance accounted for. The second component has an eigenvalue of 2.65 and explains 18.48% of the total variance. The third component has an eigenvalue of 1.85 and explains 15.58% of the total variance. The number of factors was also confirmed with the visual inspection of the scree plot, which showed a sudden drop in the scree beginning with the fourth factor as shown in Figure 2.

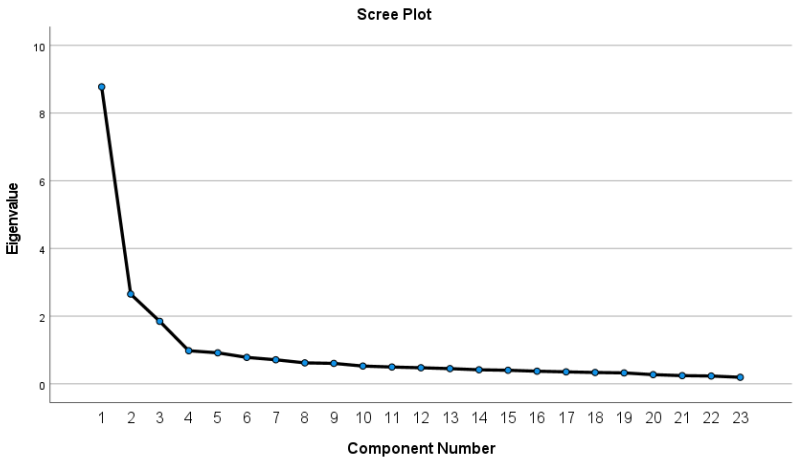

Figure 2. Scree Plot of the Eigenvalues of the Factors for a 5-Point Likert Items

Table 5 illustrates the communalities for the 5-point Likert scale, indicating the proportion of each variable's variance explained by extracted factors. They indicate the extent of common variance in the data structure that is retained following the identification of the factors. Factor loading values denote the degree and

direction of the relationship between each variable and the underlying factors, providing an indicator of the alignment of each variable with the factors (Shrestha, 2021).

The result shows that out of the 73 items in the initial survey questionnaire, a total of 23 items remained. This is because of the standardized factor loadings that were applied in the study. Hair et al. (as cited in Cheung et al., 2023) suggested that the standardized value in factor loading should be at least 0.5 and, ideally, at least 0.7, whereas Steven (as cited in Cheung et al., 2023) argued that 0.4 and above is still acceptable. The table also shows that the 23 items of the 5-point Likert items resulted in three factors. The factor loadings resulted from.618 to.824. Factor 1 included 9 items, labeled as '*Motivation on Research';* Factor 2 has 8 items, labeled as '*Attitude on Research';* and Factor 3 included 7 items, labeled as '*Competence on Research*'. Additionally, it was made sure that every factor had a minimum of three items (Dennis, 2014). Same with the 3-point Likert items, the initial survey questionnaire has three dimensions for motivation factor, namely intrinsic motivation, extrinsic motivation, and amotivation. However, the researcher decided to put them in just one dimension because this was what came out in the confirmatory factor analysis. Furthermore, none of the amotivation items had a factor analysis of 0.5 and above.

Table 5 also shows the commonalities suggest the common variance in the data set for the 5-point Likert scale. The commonality value corresponding to the first statement for the factor motivation is .71, indicating that 71% of the variance associated with this statement is common or shared by other variables. Similarly, 68%, 56%, 63%, 61%, 63%, 58%, 59%, and 40% of the common variance are associated with statements of first to ninth, respectively. For the factor attitude, the first item has a communality value of .70, which means 70% of the variance with this statement is common. Likewise, the subsequent statements show common variances of 63%, 69, 58%, 54%, and 56% for statements one through seven, respectively. While for the factor competence, the first item has .58 communality, reflecting that 58% of its variance is common. The common variance for statements one through seven is 51%, 52%, 50%, 49%, 46%, and 41%, respectively.

Table 5
Factor Loadings of Principal Component Analysis After Varimax Rotation of a 5-Point Likert Items

Items (n=23)	Communality after Extraction	Factors		
		1	2	3
Motivation on Research				
(54) The skills I have acquired in research will be helpful to me in the future.	.71	.824		
(53) I believe that the things I learn in research will be helpful.	.68	.807		
(63) I believe that research will provide me professional skills.	.66	.769		
(64) Research will give me opportunities to network with other researchers.	.63	.744		
(65) Research is useful for my career.	.61	.738		
(55) It gives me great pleasure when I learn something new while conducting research.	.63	.707		
(56) Learning about research stimulates my thinking.	.58	.683		
(67) I believe that getting involved in research will help me better prepare for the career I have chosen.	.59	.671		
(43) Doing research is important.	.40	.620		
Attitude on Research				
(51) I plan to conduct my own research in the future.	.70		.765	
(40) I have high level of interest in conducting research.	.63		.763	
(60) I am motivated to publish scientific research.	.69		.760	
(48) I enjoy my research course.	.58		.718	
(61) Lately, I have been paying attention to scientific research courses.	.54		.697	
(52) I find research interesting	.64		.682	

(50) I feel good about myself when I am involved in research.	.56	.633
Competence on Research		
(2) I know the different ways to consider of selecting a research topic.	.58	.730
(1) I know where to find the topic for research.	.51	.694
(9) I know how to conduct a comprehensive review of the literature.	.52	.692
(3) I can identify research gaps.	.50	.690
(13) I can identify the appropriate research design for my research questions.	.49	.678
(14) I am familiar with different research designs in my discipline.	.46	.655
(8) I can identify peer-reviewed journal articles.	.41	.618

Table 6
CFA Results, Summary of Item Statistics and Reliability Coefficient

	3-point Likert	5-point Likert
Eigenvalues		
First factor	7.24	8.78
Second Factor	2.58	2.65
Third Factor	2.07	1.85
Total Variance	51.67%	57.73%
Cronbach's alpha	.900	.927
Factor loadings		
Minimum	.600	.618
Maximum	.802	.824

Table 6 shows the CFA result, summary of item statistics, and reliability coefficient. It reveals that the total variance explained for 3-point Likert items of the research culture scale was 51.67%, while 5-point Likert items had 57.73%. It indicates that 5-point Likert items of the research culture scale have higher total variance. The percentage of variance for a specific item that may be attributed to the factors is shown by adding up the squared loadings for that item on a factor matrix. It is referred to as the communality. The extent to which the extracted components account for the variance of the item increases with the communality value. A factor is said to explain more variability when the percent of variance value is higher. Thus, the most important factors can be ascertained using the percent of variance values (Tavakol & Wetzel, 2020). Meanwhile, the 5-point Likert items of the research culture scale have higher variance; it therefore implies that the factors that emerged have more variability.

None of the items have factor loadings below .400, the reason why the validation scale's internal consistency was made using Cronbach's alpha. Cronbach's alpha was used to test the accuracy and reliability of the research culture scale. In the table, the 3-point and 5-point Likert items have Cronbach's alpha values of.900 and.927, respectively, which confirmed that the reliability of the research culture scale of the 3-point and 5-point Likert items is excellent. The data demonstrate a link between the variables and their respective groupings, indicating internal consistency. Furthermore, the following are the three factors that emerged during factor analysis of the 3-point and 5-point Likert items of the research culture scale:

Factor 1: Motivation for Research

The factor one for the 3-point and 5-point Likert items of the research culture scale is motivation for research. The items map out that the motivation of students to engage in research activities is due to the rewards and opportunities in their future career or profession, opportunities to network with other researchers, it gives them great pleasure, can stimulate their thinking, and they perceive research as important, which can help

them prepare for the career they have chosen. One of the key elements that energizes and drives people to participate in something by nature is motivation (Hosseini & Bahrami, 2022; Han & Yin, 2016; Ryan, 2012). In addition, motivation refers to the factors that drive individuals to make certain choices, the duration for which they are willing to engage in an activity, and the level of determination they exhibit in pursuing it (Han & Yin, 2016).

One of the types of motivation is extrinsic factors, which are comprised of tangible rewards and incentives where motivation is driven by an external environment (Nyangau, 2018), like awards, career advancement, and better opportunities or salary in the future (Esteban et al., 2022). According to Kyvik et al. (2014), training that involves research and development activities can increase a person's interest in using research in the workplace in the future. Helgøy et al. (2020), agreed that one of the primary justifications for including research into bachelor's programs in health care education, like occupational therapy education, is the promise of future high-quality health care delivery. Additionally, learners reported feeling inspired when presented with opportunities to enhance their skills and obtain recognition or incentives (Ommering et al., 2020). Allied health students' extrinsic motivation to participate in research is due to rewards and opportunities in their future career or profession. It appears to be very beneficial for those pursuing professions in allied health because research facilitates the delivery of high-quality clinical practice.

Another type of motivation is intrinsic factors, which refer to those that originate from within the individual where motivation is fueled by internal fulfillment. When someone acts because they enjoy it and feel good about it, they are said to be intrinsically motivated (Nyangau, 2018). When a person enjoys and finds fulfillment in their work, they are motivated. The intrinsic motivation of undergraduate research students is influenced by several factors. Van Blankenstein et al. (2019), discovered that relatedness, autonomy, and positive social interdependence can enhance intrinsic motivation. Significant factors that have been highlighted by Ommering et al. (2020), include self-efficacy beliefs, perceptions of research, curiosity, and the need for challenge. These results emphasize how crucial it is to establish a warm and engaging environment in order to develop students' innate desire to conduct research.

Research has demonstrated various approaches to improving motivation. These include formulating research questions based on practitioner needs, sharing research findings, and integrating research into practice to assist undergraduate students in realizing the value of research in their future work (Mckee et al., 2017; Moore et al., 2012). Creating a culture that recognizes the importance of research is another element that boosts motivation (Gullick & West, 2016; Akerjordet et al., 2012). In the study done by Helgøy et al. (2020), instructors and students emphasized how crucial it is to prioritize research to guarantee that graduates possess the skills needed to deliver future best practices. Prior studies have revealed that students strongly believe that research is important for their future clinical practice (Vereijken et al., 2018) and that they want to stay current in their profession (Kandell, 2019). Thomas et al. (2017), claimed that it is essential that students begin learning research as early as possible and ideally throughout their formal education for them to deliver best practices in their future career. According to Whelan & Markless (2012), academic dietitians in the UK also recognize the usefulness of research for their profession. It follows that the fact that professors and graduates used evidence as the basis for practice is not surprising (Palermo et al., 2014). In order to stay up to date in their field and provide the highest level of service, allied health students must value research because it will be essential to their future clinical practice.

Factor 2: Attitudes on Research

The factor two for the 3-point and 5-point Likert items of the research culture scale is attitudes toward research. The items map out the attitudes of students in engaging in research activities. These are the positive feelings towards research, like their interest, plan to conduct their own research and publish it in the future, enjoyment, and feeling good about themselves when involved in research. Even though students are equipped with the skills, knowledge, and other competencies needed for research, the affective domain also has a big impact on this process (Kakupa & Xue, 2019), and that is attitude toward research. Kakupa & Hue (2019), assert that it is crucial to study these attitudes to create strategies for fostering or maintaining positive research attitudes. According to studies, students in the fields of nutrition and dietetics value independent, hands-on research experiences in real life (Whelan et al., as cited in Davidson & Palermo, 2015), and attitudes toward research are influenced by supervisors, role models, and personal interests (Palermo et al., 2014).

Students cherish research experiences, according to Smyth et al. (2016), and they gain professional and practical skills, a better grasp of the research process, and enhanced critical thinking abilities from engaging in research. Likewise, according to Deicke et al. (2014), in order to boost students' interest in research, they should engage with real research literature, create research designs, and do empirical research. It is also aligned with earlier studies conducted on nutrition students, which demonstrated that engaging in research itself can lead to the enjoyment and development of research abilities (Davidson & Palermo, 2015; Desbrow et al., 2014). Hence, students who conduct research therefore acquire professional and practical abilities. Students should also become more independent in their research endeavors, which will therefore lead to enjoyment and increase their interest in the field.

Factor 3: Competence on Research

The factor three for the 3-point and 5-point Likert items of the research culture scale is competence in research. The items map out ways on how to select where to find a topic, how to conduct a comprehensive literature review, how to identify research gaps, how to identify research design based on research questions, and how to identify peer-reviewed journal articles. In their contexts, these models can be helpful instruments for evaluating and fostering research competency. According to scholars, competence is a very abstract term that is difficult to evaluate and measure (Loginov & Kovalev, 2017; Flinkman et al., 2017; Robinson et al., 2015; Smith, 2012), because it cannot be immediately observed (Gonczi et al., Heywood et al., Wolf, as cited in Nicholson, 2013). Competency models for various researcher types have been established and validated through a variety of studies. Cheng & Zhang (2012), concentrated on senior researchers; Vasetskaya et al. (2018), focused on research and teaching university workers; and Miyejav et al. (2023), developed a model for educational researchers. However, there is a paucity of validated instruments for research competency among allied health undergraduate students; therefore, development of validated instrument was done.

Research competence development should begin early in undergraduate training, where they should get involved in real research experience (Sismondo, 2020; Helgøy et al., 2020; Palermo et al., 2014). Likewise, Helgøy et al. (2020), found that research was seen by both faculty members and students as crucial to bachelor's degree programs to provide students with the skills they will need to deliver best practices in the future. According to Loginov & Kovalev (2017), competence is made up of three well-known categories: knowledge, abilities, and skills. The value of producing new knowledge for societal benefit should serve as the foundation for the development of research competency (Coronel-Santos & Ramírez-Montoya, 2020).

In nursing, research competency is defined as the capacity to 1) conduct a thorough review of literature and clinical experience in order to formulate researchable problems and research questions that are appropriate for nursing, 2) gather, examine, and provide details about data related to the formulated questions, and 3) creatively solve problems using the gained knowledge (Gerish & Lacey, 2010; Pan et al., 2011 as cited in Qiu et al., 2019). A comprehensive review of the literature is important in the initial phase of research. According to Palermo et al. (2014), critical reading of scientific literature was highlighted as one of the most important skills to acquire. Furthermore, enhancing research competence has been seen as a crucial strategy for advancing the growth of the nursing field and raising the standard of nursing practice (Qiu et al., 2019). However, several studies showed that Chinese undergraduate nursing students are not very proficient in research (Qiu et al., 2019; Zhao et al., 2011).

Prior to conducting research, it is essential to establish clear, relevant, and feasible study plans. The formulation of the research topic and the determination of the subject are essential elements of this procedure (Vuković et al., 2024). Grande et al. (2022), and Parahoo (2014) both agreed that undergraduate students should be aware of the steps of the research process. In research, it is crucial to formulate a carefully designed research question and topic, carry out a comprehensive literature review, and grasp the connection between theory and research (Solinger et al., 2024). Likewise, Lopes et al. (2016), highlight how important it is to develop a compelling research question because it will act as the project's cornerstone. There is a need to help undergraduate students acquire research skills early on, with a particular emphasis on professional research endeavors (Noguez & Neri, 2019). These studies collectively underline the crucial role of the beginning phase in establishing the stage for effective research. The first stages of research are crucial because they lay the foundation for the rest of the study.

To comprehend research papers, students stated that they needed to be proficient in research methods, particularly quantitative methods. Ommering et al. (2020) and DeCleene Huber et al. (2015), discovered that students were not confident when it came to interpreting study outcomes utilizing statistical tests and methods. Smyth et al. (2016), claimed that the research experience of students and the benefits they get from it improved their understanding of the research process. Helgøy et al. (2020), agreed that this strengthens the idea that instruction on research methodologies, including statistical and quantitative methodologies, ought to be incorporated into the curriculum. The result implies that students should be taught well about research data approach and analysis, especially in statistics, because they gain confidence in performing research when they are equipped to analyze data.

Studies have shown that students who receive a good mark in a research course have better nursing research abilities than students who receive a lower grade in nursing research course (Grande et al., 2022). In the study of Qiu et al. (2019), dietetic interns with higher scores on the research competency scale had a deeper grasp and implementation of the research competency in their program. Finally, the ability to execute research activities is predicated on an individual's competency (knowledge, skills, and experience) (Corchon, 2010 as cited in Chen et al., 2019). The building of research abilities must comprise three interrelated components: methodological-reflexive, motivational, and communicative (Ivanenko et al., 2015). As a result, developing research competence is crucial to enabling students to participate in research activities.

The result implies that research experiences for students ought to be planned such that they have a sense of ownership over their own studies. In practice, this could be accomplished by offering students a variety of choices when it comes to, say, the topic of their research. Students could also be encouraged to assume a leading role in carrying out their research. This not only fosters a sense of independence but is also connected to the successful teaching strategy of "learning by doing," which has been supported by several people over the years. Therefore, research culture can be developed when students have the competence to do research, and when they are competent, attitude and motivation towards research will follow, hence developing their research culture.

Furthermore, the result of the study was like the developed and validated research culture index (RCI) by Barroso & Egar (2017), wherein three factors also emerged. However, it was done among administrators, researchers, and faculty members. The factors cover research competency, research process, and research productivity with a 0.8 reliability result using Cronbach's alpha. The result of the study is in contrast with the institutional research culture scale (IRCS), which was done among faculty members. The EFA done to the study extracted five factors, namely institutional culture, working conditions, research infrastructure, research collaboration and sharing, institutional research policy and agenda, and research monitoring and mentoring (Jayachandran & Chandrasenan, 2021). These studies offer a thorough grasp of academic institutions' research cultures and how they are measured.

Model Fit of 3-Point and 5-Point Likert Items of Research Culture Scale Using Confirmatory Factor Analysis

Assessing a model's relative fit using its information criterion is a critical technique for determining which model is most appropriate to fit the data. Given that perfect model fit is rarely expected when a model is overidentified, it is essential to evaluate the actual level of model fit. Fit statistics play a crucial role in this process, demonstrating whether the models align well with the data (De Ayala, 2022; Byrne, 2013; Kline, 2023). This involves not only selecting the appropriate model but also rigorously assessing its fit to the data (De Ayala, 2022; Zanon et al., 2016). Additionally, comparing models across different parameters or values can provide insight into which model best captures the data's underlying structure (Thorpe & Favia, 2012). By carefully evaluating model fit and comparing alternatives, researchers can ensure that the chosen model provides the most accurate and meaningful interpretation of the data.

To assess the appropriateness of the model, a confirmatory factor analysis (CFA) was conducted using Analysis of Moment Structures (AMOS). A structural equation model was built using the variables from the research culture scale, which included both 3-point and 5-point Likert questions. The findings were like the results of Cheng & Zhang (2012), Böttcher & Thiel (2018), and Vasetskaya et al. (2018), which also used confirmatory factor analysis to validate the models, and their studies reported sufficient model fits.

A structural equation model using AMOS was built with three factors and 23 items for research culture were generated from the research culture scale. Figure 3 shows the three constructs' regression weights ranging from .54 to .77 of the 3-point Likert items of the research culture scale and shows the three constructs' regression weights of 5-point Likert items ranging from .56 to .82. Modifications of the model were aided using modification indices guided by the fitness indices.

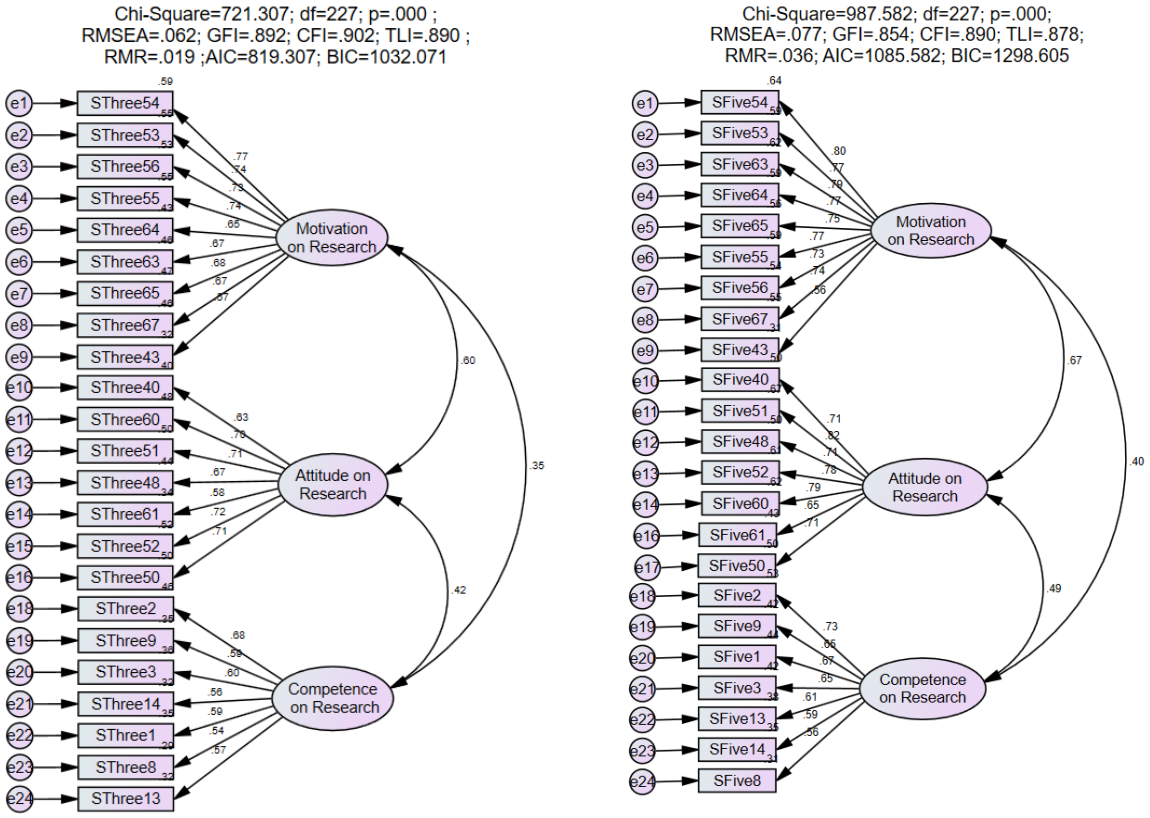

Figure 3. Flow Chart Presenting the Underlying Construct of the 3-Point and 5-Point Likert Itemsof Research Culture Scale

Table 7 shows the confirmatory factor analysis (CFA) fit indices of 3-point and 5-point Likert items of the research culture scale. The results showed that the fitness indices were enhanced after implementing cross-loading between constructs using modification indices. Table 21 shows the goodness of fit indices of CFA of 3-point Likert items and 5-point Likert items of research culture scale was measured and it revealed that both have significant chi-square (CMIN = 721.307, df = 227, *p* =.000) for 3-point Likert items and (CMIN = 987.582, df = 227, *p* = .000) for 5-point Likert items which is common in a large sample and both indicate goodness of fit. Furthermore, other fit indices that may suggest the hypothesized model has excellent fit with the sample data were also investigated. For 3-point Likert items, CMIN/DF = 3.178, RMSEA = .062, RMR = .019, TLI = .890, and CFI = .902 and for 5-point Likert items CMIN/DF = 4.351, RMSEA = .077, RMR = .036, TLI = . .878, and CFI = .890. The values obtained that both 3-point and 5-point Likert items met the overall acceptability of the model fit. It might not be an excellent fit, but it does not necessarily mean that the models are entirely useless (Shi et al., 2022). The result may suggest that both 3-point and 5-point Likert items have similar model fit, but if one bases it on CMIN/DF, 3-point Likert items have better fit than 5-point Likert items. According to Kline (1998) (as cited in Moss et al., 2015), CMIN/DF < 3 denotes an acceptable fit between the hypothetical model and sample data, whereas CMIN/DF < 5 implies a reasonable fit (Marsh & Hocevar, 1985, as cited in Moss et al., 2015).

Table 7
Confirmatory Factor Analysis (CFA) Fit Indices of 3-Point and 5-Point Likert Items

	Good fit	3-point	5-point
Chi-square		721.307	987.582
DF		227	227
p-value	$.01 \leq p \leq .05$	.000	.000
Normed chi-square (CMIN/DF)	$2 < \chi^2/df \leq 5$	3.178	4.351
RMSEA	.05 < RMSEA ≤ .08	.062	.077
RMR	0 ≤ RMR ≤ .05	.019	.036
TLI	.85 ≤ TLI <.95	.890	.878
CFI	.85 ≤ CFI < .97	.902	.890
AIC		819.307	1085.582
BIC		1032.071	1298.605

Note: ***CFI****=Comparative Fit Index,* ***RMSEA****=Root Mean Square Error Approximation,* ***RMR****=Root Mean Square Residual,* ***TLI****=Tucker-Lewis Index, CMIN/DF-chi-square/degrees of freedom,* ***AIC=****Akaike Information Criterion,* ***BIC=****Bayesian Information Criterion*

Another way of examining model data fit is by comparing in model pairs of lower AIC and BIC values from the 3-point and 5-point Likert items. According to AIC and BIC values in table 19, the model with the lower AIC and BIC values is the 3-point Likert items (AIC = 819.307; BIC = 1032.071) compared to 5-point Likert items (AIC = 1085.582; BIC = 1298.605). There is no set standard for what constitutes "good" values for AIC and BIC. However, better model fit in comparison to other models under consideration is indicated by lower values of AIC and BIC. Finally, AIC and BIC are not precise indicators of model quality; rather, they are instruments for model selection (Sözer & Kahraman, 2021). The result of the study may show that the 3-point Likert items have better model fit.

A study done by Aybek & Toraman (2022), comparing the 3-point, 5-point, and 7-point scales discovered that in terms of reliability and test information perspective in the scale development process, the use of a 5-point Likert response is more advantageous than using a 3-point Likert response. Likewise, a study done to verify the use of a 5-point Likert scale in a program implementation assessment instrument found that the 5-point Likert scale met the criteria set based on Rasch's model measurement. Thus, the use of a 5-point Likert scale was retained because it is understandable and allows respondents to make distinctions. In contrast with the study of Jeong & Lee (2016), where they compared the 2-point, 3-point, and 5-point Likert items, they found out that both the 2-point and 3-point Likert scales performed well compared to the 5-point scale. According to another investigation (Lange et al., 2020) assessing the reliability of the 3-point, 5-point, and 9-point Likert scales, the 3-point scale is the most logical option because it is the easiest to translate into a clinical setting.

Numerous investigations have examined the variables impacting study model fit. The result of this study indicates that both the 3-point and 5-point Likert items have acceptable model fit. However, the 3-point Likert items might have a better fit based on CMIN/DF, RMSEA, RMR, AIC, and BIC. Greene et al. (2022), however, issued a warning against relying too much on model fit indices, claiming that doing so may result in incorrect conclusions drawn from quantitative psychopathology research. All of these studies emphasize how crucial it is to comprehend and assess the variables that affect people's perceptions of study model fit.

Model Validity Measures of 3-Point and 5-Point Likert Items of Research Culture Scale

To examine the model validity measures, principal component analysis (PCA) was used. This is to compute composite reliability (CR), average variance extracted (AVE), and maximum variance (MSV), which were used to evaluate the construct reliability using Cronbach's alpha, convergent validity, and discriminant validity of the instrument. They are important in validating the efficiency of research instruments (Hair Jr. et al., 2021; Gefen et al., as cited in Alumran et al., 2014).

Convergent Validity

Convergent validity of the instrument was determined using the construct's AVE, which was measured and contrasted to the inter-factor correlations or internal consistency of the indicators measuring the same construct (Hair Jr. et al., 2021; Gefen et al., as cited in Alumran et al., 2014).

Table 8
Model Validity Measures of 3-Point and 5-Point Likert Items

	CR	AVE	MSV
3-point Likert Items			
Motivation	.893	.483	.358
Attitude	.854	.457	.358
Competence	.788	.348	.176
5-point Likert Items			
Motivation	.917	.555	.452
Attitude	.894	.549	.452
Competence	.827	.408	.235

***Note: CR**= Composite Reliability; **AVE**=Average Variance Extracted; **MSV**= Maximum Shared squared variance*

Table 8 shows the model validity measures of 3-point and 5-point Likert items of the research culture scale. As shown in the table, none of the Cronbach's alpha of the 3-point and 5-point scales is below 0.7 conflicting with the construct reliability requirement. For the 3-point Likert items, motivation and attitude have good reliability CR=.893 and CR=.854 respectively and competence has an acceptable reliability CR=.788. While in 5-point Likert items, motivation has excellent reliability CR=.917 and attitude and competence have good reliability CR=.894 and CR=.827 respectively). Therefore, the reliability for all construct was achieved. However, the three dimensions of 5-point Likert items have higher composite reliability compared to 3-point Likert items.

Table 8 also shows the computed AVE values of the 3-point and 5-point Likert items of the research culture scale that meet the convergent validity threshold of AVE greater than 0.3. The AVE in 3-point Likert items: motivation (.483), attitude (.457), and competence (.348) while for 5-point Likert items motivation (.555), attitude (.549), and competence (.408). Jansson (2020), recommended 0.30 and above as an accepted AVE coefficient. According to some authors, successful convergent validity is indicated by an AVE greater than 0.50, indicating that the items are assessing the same underlying construct (Cheung et al., 2024; Pahlevan Sharif et al., 2022; Hair Jr. et al., 2021), which indicates that the latent construct contributes to at least 50% of the indicator variation (Fornell & Larcker as cited in Cheung et al.). Nonetheless, the AVE value of less than 0.5 is acceptable if the composite reliability is greater than 0.6, meaning that the construct's convergent validity is acceptable (Fornell and David, as cited in Muhamad Safiih & Nor Azreen, 2016). For this reason, the value of 0.4 is acceptable. If Jansson (2020) is followed where a 0.30 AVE coefficient is acceptable, the convergent validity of all constructs is achieved for both 3-point and 5-point Likert items of the research culture scale. However, if AVE coefficient of 0.30 is not acceptable, factor competence in 3-point Likert items did not achieve convergent validity. Furthermore, comparing the construct validity of 3-point and 5-point Likert items, one will see that the latter has higher AVE coefficients across all constructs.

Table 9 also reveals the discriminant validity using MSV of 3-point and 5-point Likert items of the research culture scale. As seen in the table, the MSV values for each construct of both 3-point and 5-point Likert items are lower than the AVE values. According to Rahmatpour et al. (2021), and Ahadzadeh et al. (2015), if the values of MSV for each construct are less than the AVE values, it indicates a strong discriminant validity. Therefore, the result suggests that the constructs of both 3-point and 5-point Likert items of the research culture scale have strong discriminant validity.

Discriminant Validity

Discriminant validity of the research culture scale can be established using MSV (Hair Jr. et al., 2021; Alumran et al., 2014) and for the elements to collectively represent the latent construct, they must converge or come together (Hair Jr. et al., 2021). Another way of evaluating discriminant validity is by utilizing Fornell and Larcker criterion (Hair Jr. et al., 2021). Furthermore, for discriminant validity to be valid, each indicator must load differently on a single construct or overlapping construct (Cheung et al., 2023).

Table 9
Fornell-Larcker Criterion for the Constructs Motivation, Attitude, and Competence of 3-Point and 5-Point Items of Research Culture Scale

	Motivation	Attitude	Competence
3-point Likert Items			
Motivation	**.695**	-	
Attitude	.598	**.676**	-
Competence	.346	.419	**.590**
5-point Likert Items			
Motivation	**.745**	-	
Attitude	.672	**.741**	-
Competence	.403	.485	**.639**

Table 9 shows the Fornell-Larcker criterion for constructs motivation, attitude, and competence of 3-point and 5-point Likert items of the research culture scale. This is another way of evaluating the discriminant validity of the instrument. It reveals that in 3-point Likert items, the construct motivation has a value of .695 for the square root of its AVE. This value is higher than the attitude (.598) and competence (.346). As for the construct attitude, it has a value of .676 for the square root of its AVE which is greater than competence (.419); whereas the construct competence has a value of .590. Furthermore, in 5-point Likert items, the construct motivation has a value of .745 for the square root of its AVE. This value is higher than attitude (.672) and competence (.403). As for the construct attitude, it has a value of .741 for the square root of its AVE which is greater than competence (.485). Whereas the construct competence has a value of .639. The results indicate the square root of its AVE is higher than the correlation it has with any other construct. According to Hair Jr. et al. (2021), the factor loading indicators on the chosen construct need to be greater than the correlation of all loadings of the other constructs. Therefore, the discriminant validity is achieved because the bold values are higher than the other values in its row and column.

Numerous studies have focused on convergent and discriminant validity, which are essential components of construct validity. However, researchers emphasized the need for validating instruments using convergent and discriminant validity. They highlight how important discriminant and convergent validity are in maintaining the reliability and accuracy of measures (Barroso & Egar, 2017; Schweizer, 2014). Strong validity evidence is critical because there are few validated instruments measuring different aspects of research culture (Jayachandran & Chandrasenan, 2021; Barroso & Egar, 2017). The results of the study showed that for both the 3-point and 5-point scales, the factor motivation had the greatest impact. It has the highest composite reliability, has an acceptable AVE coefficient, and the factor loading is higher than the other value in its row and column. While the research culture index (RCI) created by Barroso & Egar (2017), assessed the research productivity, process, and competency in academic institutions, research competency had a major impact. In contrast with the result of the study, in which an AVE coefficient of 0.30 is not acceptable, factor competence in 3-point Likert items did not achieve the convergent validity.

Furthermore, comparing the convergent validity of the 3-point and 5-point Likert items, the latter has the better AVE coefficient that achieved the acceptable values. According to Chakrabartty's (2023) research, factorial validity, reliability, and discriminating value were not substantially impacted by the quantity of response categories. Consequently, the study was unable to determine the ideal number of response categories to increase discriminating value, validity, or reliability. Abal et al. (2018), argued that increased test reliability was observed at the extremes of the trait on Likert scales with more categories, but at the expense

of compromising the validity evidence of the internal structure. Similarly, forms with three, five, and seven response options have reliability above .90, but the form with five response options has the greatest validity estimation, according to a study done on a group of youngsters between the ages of 10 and 12 (Gonzalez-Betanzos et al., 2012). The result of the study may imply that the 5-point Likert items of the research culture scale may have better construct validity than 3-point Likert items because it might be affected by the greater number of scale steps.

Like the study conducted by Jeong & Lee (2016), which compared the effectiveness of 3-point and 5-point Likert scales, both scales showed strong correlation coefficients with the measured variables. Interestingly, the 3-point scale particularly excelled in performance, suggesting its efficacy in capturing accurate responses from participants. According to Dalmoro & Vieira (2013), the 3-point scale is the simplest and fastest to use, and it is easier for the respondents to understand and choose quickly. Furthermore, Chang et al. (as cited in Aybek & Toraman, 2022) found that scales with fewer response categories yielded greater reliability values. Likewise, the study of Fang et al. (2011), discovered that certain groups, such as individuals with intellectual disabilities (ID), have shown improved response validity and reliability with a 3-point Likert scale compared to a 5-point scale. Their findings suggest the use of a 3-point Likert scale for ID respondents within the context of the WHOQOL-DIS module. Borgers et al. (as cited in Alan & Kabasakal, 2020) asserted that employing an excessive number of options for responses in Likert-type scales while assessing youngsters would impose a cognitive burden on them. However, there are additional research findings that indicate that children can utilize the 4-point and even the 5-point variations of the scales (Adelson & McCoach, 2010; González-Betanzos et al., 2012).

On the contrary, Taherdoost (2019), claimed that short rating scales do not provide much insight into how people distinguish between a wide range of objects, and several studies have found that longer scales offer more detailed data. Similarly, Dalmoro & Vieira (2013), noted that a 5-point scale is more dependable and better at capturing respondents' perspectives. The research conducted by Alan & Kabasakal (2020), also reveals that the psychometric properties of scales can be enhanced by increasing the number of response alternatives. Jeong & Lee (2016) also noted that a 5-point Likert scale inherently offers more nuanced information due to its four switching points between "strongly disagree" and "strongly agree," providing respondents with multiple response alternatives. In contrast, a scale with fewer options concentrates responses within a narrower range of the latent trait continuum, potentially forcing respondents to take a definitive stance. Another significant concern is that once a neutral respondent leans towards either agreeing or disagreeing on one item, they may tend to answer subsequent items in a similar way, adding bias (Nickerson, as cited in Jeong & Lee, 2016). The result suggests that a longer rating scale offers more detailed and nuanced data compared to shorter scales. Conversely, a shorter scale may limit responses to a narrower range of the latent trait continuum and can introduce bias, as respondents may feel compelled to take a definitive stance.

As a result, while the 3-point Likert scale can offer better data characteristics in some contexts, the selection of the scale should be carefully considered based on the population and the specific research setting. These contradicting findings may imply that the ideal number of points may vary depending on the setting, demographic, and method of analysis. To provide the most appropriate and successful measurement for their study, researchers should carefully examine these variables while constructing their scales.

4 Conclusion

The purpose of this study is to compare the effectiveness of 3-point and 5-point Likert scales of research culture among allied health undergraduate students using confirmatory factor analysis. It was found out that both 3-point and 5-point Likert items of the research culture scale have a marvelous level of KMO and a significant result for Bartlett's test of sphericity. The result revealed that out of the 73 items in the initial survey questionnaire, a total of 23 items remained. It indicated that both the 3-point and 5-point Likert items of the research culture scale still obtained three factors by confirmatory factor analysis (CFA). Factor 1 has 9 items labeled as '*Motivation on Research*', Factor 2 has 7 items labeled as '*Attitude on Research*', and Factor 3 has 7 items labeled as '*Competence on Research*'. Both scales have excellent reliability using Cronbach's alpha. Furthermore, the goodness-fit indices of the first-order confirmatory analysis (CFA) indicated an acceptable

fit. The values obtained that both 3-point and 5-point Likert items met the overall acceptability of the model fit. It might not be an excellent fit, but that does not necessarily mean that the models are entirely useless. The result may suggest that both 3-point and 5-point Likert items have similar model fit, but if one bases it on CMIN/DF, 3-point Likert items have a better fit than 5-point Likert items. According to AIC and BIC values, the model with the lower AIC and BIC values is the 3-point Likert items compared to 5-point Likert items. There is no set standard for what constitutes "good" values for AIC and BIC. However, better model fit in comparison to other models under consideration is indicated by lower values of AIC and BIC. The findings also revealed that all dimensions of 3- and 5-point Likert items achieve the criteria for convergent and discriminant validity. In convergent validity, 5-point Likert items have higher composite reliability, and in construct validity, 5-point Likert items have better AVE coefficients. Both scales have strong discriminant validity using MSV; however, using the Fornell-Larcker criterion, the 5-point Likert scale has better construct validity. Upon doing the comparative study, the researcher recommends the use of the 5-point Likert scale of the research culture instrument as it offers more nuanced information due to its four switching points between "strongly disagree" and "strongly agree," providing respondents with multiple response alternatives. In contrast, a scale with fewer options concentrates responses within a narrower range of the latent trait continuum, potentially forcing respondents to take a definitive stance.

The result of the study highlighted the strengths and weaknesses of each scale using confirmatory factor analysis and validity. The study is not free of limitations. The study compared the 3-point and 5-point Likert items on the research culture scale among allied health college students from selected sectarian institutions in the Philippines. A total of 1,139 individuals took part in the study, with 568 respondents using a 3-point scale and 528 respondents using a 5-point scale. However, it may not be a good representative for a study and may not be considered as having good generalizability. For future research, the researcher intends to expand the sample size to include students from various programs, not limited to allied health, and from multiple universities, not exclusively to the selected sectarian institutions. To further investigate this topic, it is recommended to do additional replications with respondents from various professional backgrounds and age groups, comparing odd and even response categories or Likert scales.

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