The Use of Factor Analysis and Cluster Analysis Methods to Identify the Most Crucial Key Factors Influencing the Psychological Stability of University Students

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Abstract-This research aimed to use factor analysis and cluster analysis approaches to evaluate the crucial components influencing the psychological stability of students at Salahaddin University-Erbil. To obtain our data, we selected a sample size of 149 students and surveyed them with twenty-two items about their psychological stability. According to the findings of both methods, six common factors or clusters influence the psychological stability of students labeled (Anxiety, Satisfaction, Relationship, Health, Simplicity, and Participation). Furthermore, according to the results of both methods, the first factor and the first cluster, anxiety, have the most significant effect on the psychological stability of university students compared to the other variables. Consequently, it is suggested that universities should emphasize the psychological stability of students and provide training courses for academic staff by educational and psychological experts so that they can treat the students better and understand their psychological instability situations.

Key Words: Psychological Stability, Factor Analysis, Cluster Analysis, Eigen Values, University Students.

1. INTRODUCTION

Naturally, students will experience anxiety and psychological instability as they transmission to the unfamiliar atmosphere of the university education. One possible explanation for this is the transition to a new educational system, the sociocultural aspects of college life, or the emotional pressure of being far from home and family. Some may have to attend to numerous work and family responsibilities despite academic pressure (Pedrelli et al, 2015). While some students have no problem adapting to university-level work or making new social connections, others may struggle to adjust academically or psychologically (Brook and Willoughby, 2015).

Even though there were much discussion and research on how to improve the university education system and determine the attitudes of teachers and students toward the factors that significantly impact this issue, concentrating more attention on students' psychological issues, which may be caused by the atmosphere of the university or any other condition that may affect achievement in the long run, is crucial if we would like to improve the education system's success and teaching methods in universities (Mahmood et al, 2018; Kadir and Omer, 2021; Mahmood et al, 2022).

A university student's success is influenced by mental ability, physical health, mental health, and socio-demographic predictors associated with mental disorders which leads students to be more successful in this environment due to various circumstances (Mahmood et al, 2018; Birdawod, 2022; Dusselier, 2005; Vaingankar, 2013).

The results showed a negative and statistically significant correlation between psychological instability and GPA. The study's findings also connected mental and physical health problems. Students who reported high-stress levels or difficulties managing stress also stated physical health issues, such as difficulties with diet and sleep (Birdawod, 2022; Hartley, 2011).

Approximately seven out of ten persons in the United States feel daily moderate anxiety or stress, according to recent research. Decreased academic performance has been associated with psychological discomfort, such as anxiety and depression (Dyrbye,

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2006; Beiter, 2015; Holliday, 2016). According to the study's findings, college students need to participate in various social activities during the transition to college. As a consequence of this, difficulties in building social support may be detrimental to academic achievement. Conditions related to psychological situations, such as anxiety and sadness, can make it challenging to develop or create social support. (Brook and Willoughby, 2015; Goguen et all, 2010; Wenson et al, 2008; Woolf et al, 2012; Bisson, 2017)

1.1 Research Questions

1. What is psychological stability of in general?
2. What are the most important factors that effects of psychological stability of university students.

1.2 Objective of the study

1. The research aims to recognize the common factors affecting the psychological stability of university students.
2. Utilizing two kinds of statistical methods, factor analysis and clustering analysis approaches, to describe and highlight the most influential factors in the psychological stability of university students helps educational and psychological professionals to understand better and come up with a more suitable method to assess the severity of psychological instability.

1.3 Research Hypothesis

Based on the main objective of this study, the essential hypothesis of this research are as follows:

- There is not any significant factor affecting the psychological stability of university students.

1.4 The significance of the study

This study will allow both psychologists and educational professionals to easily understand the mental health of university students and find solutions for them in an appropriate and quick manner.

2. METHODOLOGY

The essential goal of this work is to analyze the data collected by the survey questionnaire concerning the impact of psychological stability on the academic levels of the students from Salahaddin University in Erbil. There are twenty-two questions regarding the psychological stability of students, and 149 students were randomly selected to collect our data. In addition, a five-point Likert-type scale was used to rate the responses to the questions, which were labeled from "strongly disagree" at the lowest level to "strongly agree" at the highest level. Then we use statistical methods of factor analysis and cluster analysis by using a JMP-Pro, version 16 software package to analyze our data to show the most important factors that may affect the psychological stability of students in the Kurdistan Region of Iraq.

3. ANALYSIS and RESULTS

As a result of Figure 1 and Table 1, there is the strongest correlation between (X18 and X20) at 0.97, while the correlation between (X1 and X3), (X3 and X17), (X13 and X17), and (X5 and X21) are the weakest at 0. In addition, most of the correlations between variables are in the positive direction. In other words, as the variable goes up, so do the other variables, and vice versa.

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Table 1
Correlation Matrix Between Variables

	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10	x11	x12	x13	x14	x15	x16	x17	x18	x19	x20	x21	x22
x1	1	-0.01	0.00	0.04	-0.23	0.20	0.16	0.92	-0.21	-0.01	-0.13	0.11	0.10	-0.20	-0.22	-0.25	0.01	0.58	-0.01	0.74	-0.12	0.51
x2	-0.01	1	0.62	-0.05	-0.09	0.49	0.30	0.01	-0.25	0.11	-0.03	0.31	0.13	-0.06	0.11	0.01	0.09	0.13	0.04	0.09	0.07	0.13
x3	0.00	0.62	1	-0.10	-0.07	0.53	0.25	0.02	0.02	0.09	-0.01	0.25	0.43	-0.08	0.05	0.03	0.00	0.16	0.02	0.12	0.11	0.16
x4	0.04	-0.05	-0.10	1	-0.05	0.03	0.27	-0.02	-0.09	-0.11	0.03	-0.05	-0.01	-0.06	-0.17	-0.03	0.19	0.05	-0.11	0.05	0.30	0.03
x5	-0.23	-0.09	-0.07	-0.05	1	-0.11	-0.23	-0.19	0.10	-0.07	0.77	-0.07	0.02	0.78	0.29	0.82	0.02	-0.06	-0.11	-0.10	0.00	-0.03
x6	0.20	0.49	0.53	0.03	-0.11	1	0.26	0.23	-0.80	0.07	-0.02	0.39	0.43	-0.08	-0.01	-0.04	0.06	0.27	-0.15	0.29	0.02	0.31
x7	0.16	0.30	0.25	0.27	-0.23	0.26	1	0.18	-0.20	0.23	-0.12	0.31	-0.05	-0.22	-0.27	-0.20	0.08	0.22	-0.15	0.24	0.37	0.23
x8	0.92	0.01	0.02	-0.02	-0.19	0.23	0.18	1	-0.24	0.02	-0.08	0.14	0.08	-0.18	-0.21	-0.23	-0.03	0.68	0.05	0.83	-0.08	0.70
x9	-0.21	-0.25	0.02	-0.09	0.10	-0.80	-0.20	-0.24	1	-0.05	0.01	-0.33	0.02	0.08	0.09	0.08	-0.07	-0.19	0.22	-0.25	0.04	-0.25
x10	-0.01	0.11	0.09	-0.11	-0.07	0.07	0.23	0.02	-0.05	1	-0.01	0.44	-0.05	-0.09	-0.04	-0.06	-0.07	0.09	0.04	0.07	-0.02	0.07
x11	-0.13	-0.03	-0.01	0.03	0.77	-0.02	-0.12	-0.08	0.01	-0.01	1	-0.04	-0.05	0.31	0.16	0.52	-0.01	0.04	-0.15	0.02	-0.03	0.06
x12	0.11	0.31	0.25	-0.05	-0.07	0.39	0.31	0.14	-0.33	0.44	-0.04	1	0.02	-0.14	-0.06	-0.08	0.03	0.09	-0.02	0.12	-0.08	0.12
x13	0.10	0.13	0.43	-0.01	0.02	0.43	-0.05	0.08	0.02	-0.05	-0.05	0.02	1	0.06	0.18	0.08	0.00	0.16	0.10	0.13	0.02	0.13
x14	-0.20	-0.06	-0.08	-0.06	0.78	-0.08	-0.22	-0.18	0.08	-0.09	0.31	-0.14	0.06	1	0.22	0.77	0.01	-0.08	-0.09	-0.11	-0.01	-0.04
x15	-0.22	0.11	0.05	-0.17	0.29	-0.01	-0.27	-0.21	0.09	-0.04	0.16	-0.06	0.18	0.22	1	0.22	0.11	-0.01	0.17	-0.09	-0.06	-0.04
x16	-0.25	0.01	0.03	-0.03	0.82	-0.04	-0.20	-0.23	0.08	-0.06	0.52	-0.08	0.08	0.77	0.22	1	0.01	-0.13	-0.07	-0.17	-0.01	-0.11
x17	0.01	0.09	0.00	0.19	0.02	0.06	0.08	-0.03	-0.07	-0.07	-0.01	0.03	0.00	0.01	0.11	0.01	1	0.05	-0.05	0.04	0.06	0.04
x18	0.58	0.13	0.16	0.05	-0.06	0.27	0.22	0.68	-0.19	0.09	0.04	0.09	0.16	-0.08	-0.01	-0.13	0.05	1	0.01	0.97	0.07	0.93
x19	-0.01	0.04	0.02	-0.11	-0.11	-0.15	-0.15	0.05	0.22	0.04	-0.15	-0.02	0.10	-0.09	0.17	-0.07	-0.05	0.01	1	-0.09	0.08	-0.13
x20	0.74	0.09	0.12	0.05	-0.10	0.29	0.24	0.83	-0.25	0.07	0.02	0.12	0.13	-0.11	-0.09	-0.17	0.04	0.97	-0.09	1	0.02	0.92
x21	-0.12	0.07	0.11	0.30	0.00	0.02	0.37	-0.08	0.04	-0.02	-0.03	-0.08	0.02	-0.01	-0.06	-0.01	0.06	0.07	0.08	0.02	1	0.06
x22	0.51	0.13	0.16	0.03	-0.03	0.31	0.23	0.70	-0.25	0.07	0.06	0.12	0.13	-0.04	-0.04	-0.11	0.04	0.93	-0.13	0.92	0.06	1

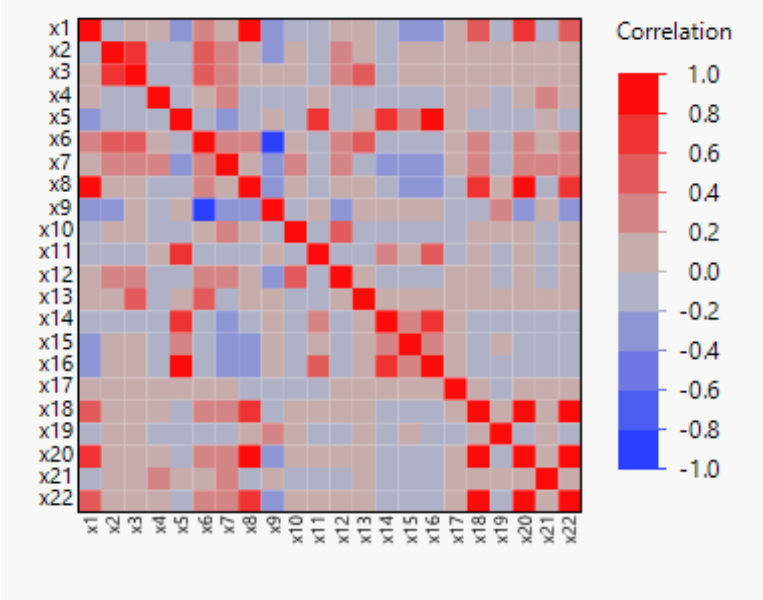

Figure 1: Scatterplot of Correlation Matrix

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Kaiser-Meyer-Olkin Test

variable	MSA	Variable	MSA
X1	0.739	X12	0.842
X2	0.893	X13	0.912
X3	0.878	X14	0.734
X4	0.685	X15	0.591
X5	0.697	X16	0.729
X6	0.838	X17	0.877
X7	0.870	X18	0.671
X8	0.539	X19	0.710
X9	0.858	X20	0.821
X10	0.815	X21	0.721
X11	0.769	X22	0.551
Overall MSA	**0.803**		

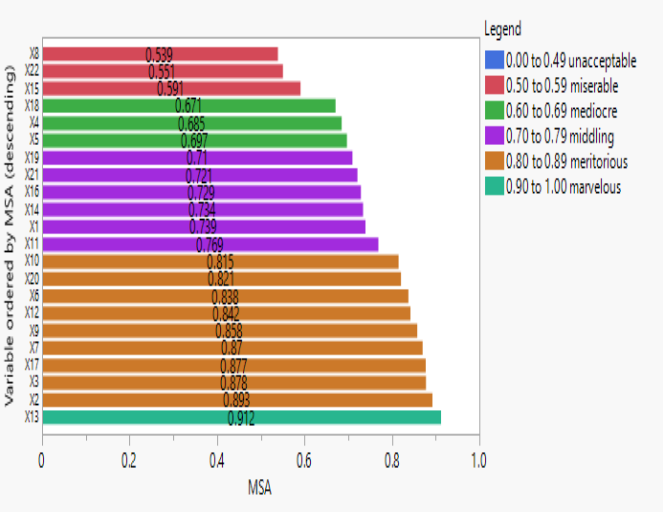

Figure 2: Scree Plot to select the number of factors

Table 3 depicts Bartlett's Test of Sphericity, in which the Chi-square value = 818.998 and (p-value = 0.0001) indicates that the factor analysis method is significant and appropriate for this dataset.

Table 3
Bartlett's Test of Sphericity

Chi-Square	DF	Prob>Chi-Square
818.998	231	<.0001*

According to table 4 and a scree plot of figure 3, only the first six components have eigenvalues greater than one. For this, only these six components should be taken. In other words, the factor analysis method reduces the twenty-two variables to just six factors, which are then used as the main predictor variables in our research. Also, each eigenvalue represents the variance measured in the correlation matrix and the amount of variation explained by each component. Furthermore, the less important components can be ignored because of less information loss. As a result, the six extracted eigenvalues altogether explain 62.213% of the variations on twenty-two variables, in which the explanations by first eigenvalue = 18.997%, second eigenvalue = 11.663%, third eigenvalue = 10.002%, fourth eigenvalue = 8.015%, fifth eigenvalue = 7.177%, and sixth eigenvalue = 6.359%. The remaining 37.787% of the variation is unexplained by the factor analysis method.

Table 4
Total Variance Explained by Eigenvalue

DOI: 10.25156/ptjhss.v4n1y2023.pp 779-789

Number	Eigenvalue	Percent	20 40 60 80	Cum Percent
1	5.3948	18.997		18.997
2	1.7305	11.663		30.660
3	1.6938	10.002		40.662
4	1.3028	8.015		48.677
5	1.2031	7.177		55.854
6	1.1557	6.359		62.213
7	0.9621	5.379		67.592
8	0.9056	4.184		71.776
9	0.8629	3.911		75.687
10	0.7812	3.761		79.448
11	0.7524	3.216		82.665
12	0.7182	3.008		85.672
13	0.6472	2.631		88.303
14	0.6027	2.327		90.630
15	0.5547	2.016		92.645
16	0.5253	1.919		94.564
17	0.4620	1.479		96.044
18	0.4007	1.198		97.242
19	0.3694	1.056		98.298
20	0.3289	0.872		99.169
21	0.3117	0.637		99.807
22	0.2344	0.193		100.000

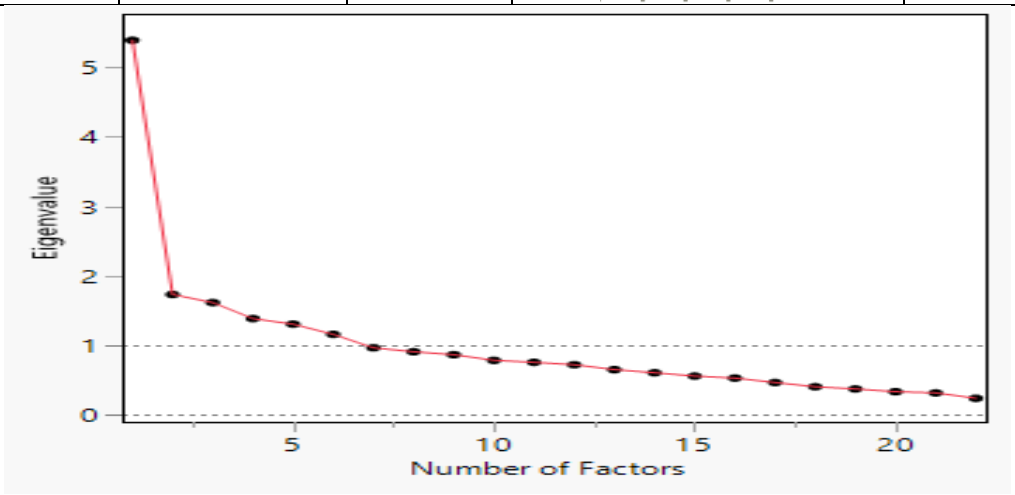

Figure 3: Scree Plot to select the number of factors

To be more particular about the number of factors required for our data, it is necessary to use the following significance tests. The first test in Table 5 indicates whether the model has no common factors or has at least one common factor. According to the results, there is evidence to reject the null hypothesis since the p-value < 0.0001, and it is less than 0.05. In other words, our model has at least one common factor.

DOI: 10.25156/ptjhss.v4n1y2023.pp 779-789

Table 5
First Significance Test

Test	DF	Chi-Square	Prob> Chi-Square
H0: no common factors.	210	777.657	<.0001*
HA: at least one common factor.			

According to the results of the following test in Table 6, since the p-value is greater than $\alpha = 0.05$, there is not sufficient evidence to reject the null hypothesis. As a result, six factors are sufficient for our dataset.

Table 6
Second Significance Test

Test	DF	Criterion	Chi-Square	Prob> Chi-Square
H0: 6 factors are sufficient.	99	0.577	79.201	0.9286
HA: more factors are needed.				

Table 7 shows the rotated factor loading, which is the final factor structure that was used to analyze all the variables, and the results are as follows:

The variables (X18, X20, X1, X8, and X22) have a great connection to Factor-I, in which X18 plays a more significant role in creating this factor than all the other variables. (Which can be referred to as the factor of Anxiety)

The variables (X5, X14, X11, X16, and X15) have a good correlation to Factor-II, and X5 has the most significant correlation to this factor compared to other variables. (Which can be referred to as the factor of Satisfaction)

- The variables (X3, X13, X2, and X6) have a great correlation to the Factor-III, and X3 has the strongest connection to this factor. (Which can be referred to as the factor of Relationship)
- The variables (X10 and X12) have a great correlation to the Factor-IV, and X10 has the strongest connection to this factor. (Which can be referred to as the factor of Health)
- The variables (X21, X4, X7, and X17) have a great correlation to the Factor-V so that X21 shows the strongest correlation to this factor. (Which can be referred to as the factor of Simplicity)
- The variables (X9 and X19) have a great connection to the Factor-VI, and X9 represents the strongest correlation to this factor compared to others. (Which can be referred to as the factor of Participation).

- The variables (X3, X13, X2, and X6) have a significant correlation to Factor-III, and X3 has the most vital connection to this factor. (Which can be referred to as the factor of Relationship)
- The variables (X10 and X12) have a great correlation to Factor-IV, and X10 has the strongest connection to this factor. (Which can be referred to as the factor of Health)
- The variables (X21, X4, X7, and X17) have a great correlation to Factor-V, and X21 shows the strongest correlation to this factor. (Which can be referred to as the factor of Simplicity)
- The variables (X9 and X19) have a great connection to Factor-VI, and X9 represents the strongest correlation to this factor compared to others. (Which can be referred to as the factor of Participation).

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
x18	0.877770					
x20	0.862664					
x1	0.762839					
x8	0.723153					
x22	0.688460					
x5		0.954737				
x14		0.779740				
x11		0.772932				
x16		0.683547				
x15		0.331755				
x3			0.802587			
x13			0.706591			
x2			0.654331			
x6			0.619839			
x10				0.786236		
x12				0.725841		
x21					0.770655	
x4					0.717339	
x7					0.613453	
x17					0.259300	
x9						0.796054
x19						0.621762

Table 8 shows the variance explained by each factor. According to the results, the six factors explain 62.213 in variation of the psychological stability of the

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students. The most considerable explanation of the variation is Anxiety, which is explained 1by 4.736%, followed by Satisfaction explained by 13.372%, Relationship explained by 10.201%, Health explained by 8.183%, Simplicity explained by 8.064% and Participation explained by 7.658%.

Table 8
Variance Explained by Each Factor

Factor	Variance	Percent	Cum Percent
Anxiety	3.2420	14.736	14.736
Satisfaction	2.9418	13.372	28.108
Relationship	2.2442	10.201	38.309
Health	1.8002	8.183	46.492
Simplicity	1.7741	8.064	54.556
Participation	1.6847	7.658	62.213

The standard score coefficients of the variables in each factor are shown in Table 9. According to the findings, X18 is the most significant variable on the first factor, with a scoring coefficient of 0.285005. In other words, this variable has a 28.50% positive influence on the first factor. Likewise, X5 is the most crucial variable in factor two, with a scoring coefficient of 0.338027 in the positive direction. Furthermore, the most influential variables in the positive direction for factors three, four, five, and six are X3, X10, X21, and X9, with score coefficients of 0.357410, 0.479260, 0.470935, and 0.486270, respectively.

Table 9
Standard Score Coefficients

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
x1	0.242331					
x2			0.270989			
x3			0.357410			
x4					0.414975	
x5		0.338027				
x6			0.269495			
x7					0.327181	
x8	0.246949					
x9						0.486270
x10				0.479260		
x11		0.285144				
x12				0.398253		
x13			0.355082			
x14		0.269699				
x15		0.095517				
x16		0.232908				
x17					0.143836	
x18	0.285005					
x19						0.398411
x20	0.270185					
x21					0.470935	
x22	0.226652					

Figure 4 shows a dendrogram, a tree diagram that uses the ward method to describe the relationships between all the data points of the twenty-two variables for the psychological stability of student universities. The dendrogram nodes represent the clusters, and the length of the branches denotes the distance between the clusters. As a result, the highest number of cluster solutions demonstrated in this study is six clusters represented in different colors.

DOI: 10.25156/ptjhss.v4n1y2023.pp 779-789

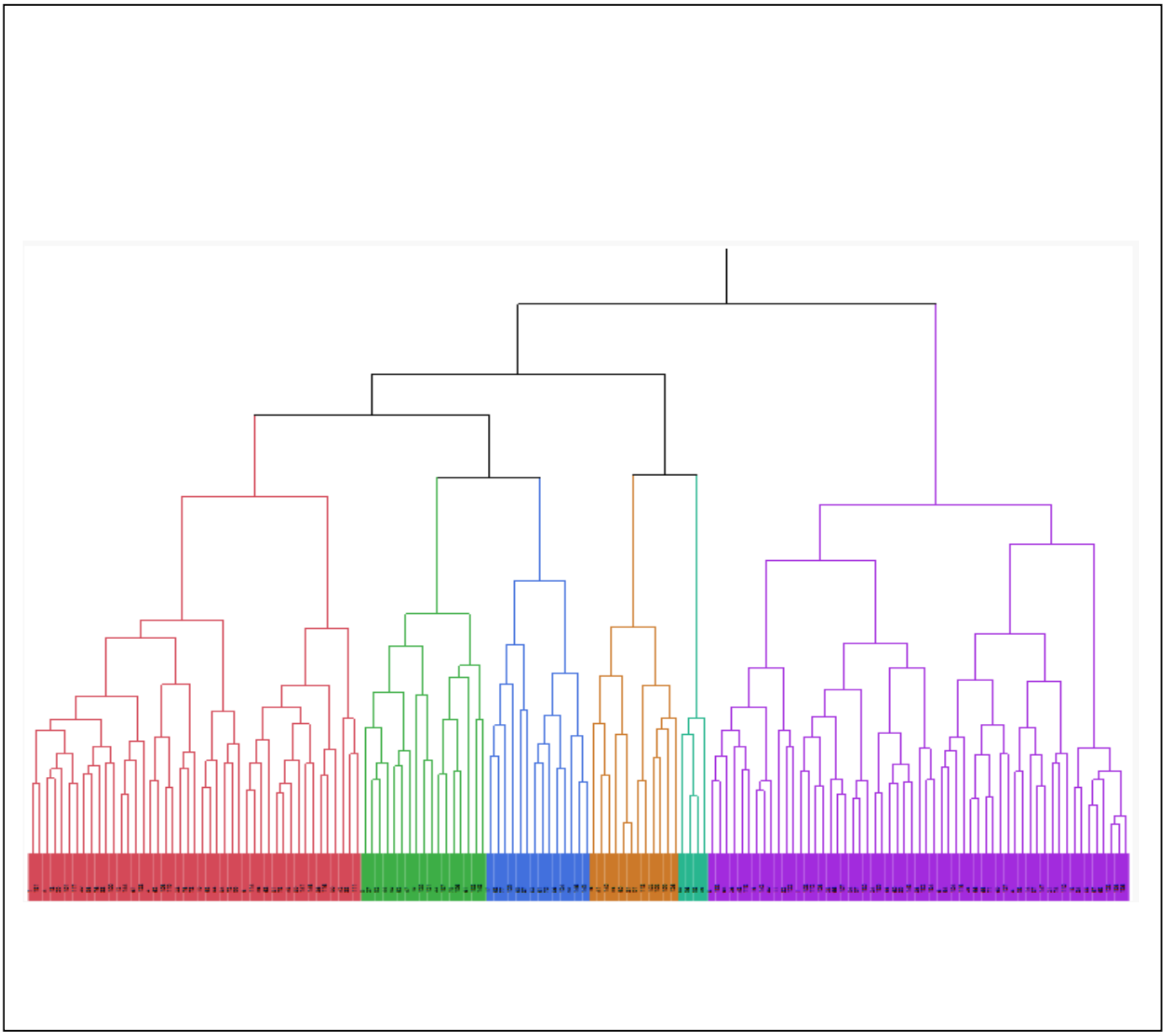

Figure 4: Dendrogram with Ward Method

The constellation plot shown in Figure 5 can be used to clarify the number of clusters needed for this study. According to the results, there are six different color groups or clusters. In other words, each different color indicates a cluster, and differences between groups can be easily seen.

DOI: 10.25156/ptjhss.v4n1y2023.pp 779-789

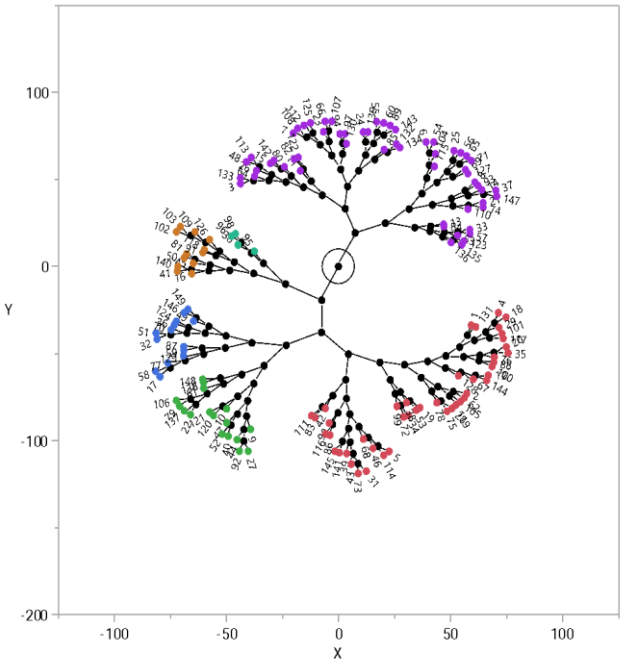

Figure 5: Constellation Plot

According to the results of table 10, cluster one has five variables, of which the variable X20 is the most significant variable in it. The total proportion of variation explained by this cluster is 14.4%. The following is cluster two, which explains 12.6% of variation with five variables, and the most significant variable in this cluster is X5. Likewise, Cluster three explained 9.9% of the total proportion of variation with four variables, indicating X3 has the most critical role in this cluster. Furthermore, Cluster five, Cluster four, and Cluster six explained 7.6%, 6.6%, and 5.50% of the total proportion of the variation, respectively. In a way, Cluster five includes four variables, of which X21 is the most significant. Cluster four includes two variables, of which X10 is the most significant. Finally, Cluster six includes two variables, of which X19 is the most significant. All six clusters together explained 56.6% of the variation. As the factor analysis method results, clusters can be labeled as (Anxiety, Satisfaction, Relationship, Health, Simplicity, and Participation).

Table 10
Cluster Summary

Cluster	Number of	Most	Total	.20 .40 .60 .80
1	5	x20	0.144	
2	5	x5	0.126	
3	4	x3	0.099	
5	4	x21	0.076	
4	2	x10	0.066	
6	2	x19	0.055	
Proportion of variation explained by clustering			56.6%	

Table 11 shows all the member variables belonging to each cluster and explains the R-squared of each variable with its own cluster and the next one. To clarify more.

- Cluster one has X20, X18, X1, X8, and X22 that X20 has the highest R-square 79.40% with this cluster.
- Cluster two has X5, X14, X11, X16, and X15 that X5 has the highest R-square 92.10% with this cluster.
- Cluster three has X3, X2, X6, and X13 that X3 has the highest R-square 74.20% with this cluster.
- Cluster four has X10 and X12 that X10 has the highest R-square 72.10% with this cluster.
- Cluster five has X21, X4, X7, and X17 that X21 has the highest R-square 54.10% with this cluster.
- Cluster six has X19 and X9 that X19 has the highest R-square 61% with this cluster.

DOI: 10.25156/ptjhss.v4n1y2023.pp 779-789

Table 11
Cluster Members

Cluster	Members	R-Square with Own Cluster	R-Square
1	x20	0.794	0.055
1	x18	0.79	0.049
1	x1	0.605	0.078
1	x8	0.51	0.022
1	x22	0.467	0.018
2	x5	0.921	0.014
2	x14	0.638	0.018
2	x11	0.563	0.008
2	x16	0.508	0.055
2	x15	0.139	0.036
3	x3	0.742	0.04
3	x2	0.523	0.062
3	x6	0.504	0.16
3	x13	0.404	0.013
4	x10	0.721	0.01
4	x12	0.721	0.071
5	x21	0.541	0.014
5	x4	0.498	0.016
5	x7	0.52	0.102
5	x17	0.119	0.006
6	x19	0.61	0.007
6	x9	0.609	0.056

4. CONCLUSIONS

The essential aim of this research was to investigate the most common factors affecting the psychological stability of university students. The following are the most noteworthy findings

- According to the results, both approaches of factor analysis and cluster analysis methods selected the same variables to generate six factors and six clusters, respectively.
- With the factor analysis method, the six factors altogether explain 62.213 in a variation of the psychological stability of the student. The largest explanation of the variation is anxiety explained at 14.736%, followed by satisfaction explained at 13.372%, relationships explained at 10.201%, health explained at 8.183%, simplicity explained at 8.064%, and participation explained at 7.658%.
- With cluster analysis methods, all six clusters together explained 56.6% of the variation. The total proportion of variation explained by anxiety is 14.4%. The following is satisfaction, which explained 12.6% of the variation. Likewise, relationships explained 9.9% of the total proportion of variation. In addition, the health of the students, simplicity, and participation explained 7.6%, 6.6%, and 5.50% of the total proportion of the variation, respectively.
- The anxiety of the students is the most important factor in both methods that impact the psychological stability of university students. Then the satisfaction of students will play an effective role in increasing their psychological stability. Followed by the student's relationship with others is a leading factor that has a high impact on their mental stability. Furthermore, the student's health, the simplicity of the students, and the participation of university students are three other factors necessary to psychological stability among university students.

Recommendations

- To further confirm the results obtained in this study, it is recommended that similar studies should be conducted in other universities in the Kurdistan Region with larger datasets and different factors to determine the common factors influencing the psychological stability of students.
- Other studies should be conducted to discover the significant psychological stability factor based on the student's gender, age, and academic level.

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