

The Factorial Structure of the Social Communication Scale Using Exploratory and Confirmatory Factor Analysis

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Abstract

The purpose of this study was to examine the factor structure of the Social Communication Scale to determine the number of its latent factors. An exploratory factor analysis was conducted on a sample of 370 primary school students using principal axis factoring with oblique rotation. The results showed that the scale had a two-factor structure. Confirmatory factor analysis was conducted using the AMOS procedure, and the results confirmed that the two-factor structure of the scale was consistent with its theoretical basis. The fit index also showed high values according to the acceptance criteria.

The study also showed good internal consistency coefficients using hierarchical alpha coefficients and split-half method and using convergent validity and internal consistency validity.

1. Introduction

Looking at various educational thoughts and psychological theories, most of them emphasize the importance of middle childhood and its impact on the individual's future life. Each theory or thought explains this period from a specific perspective. The existence of students in social and school environments restricts and controls their behavior and reactions, especially in terms of interaction with others in various social situations. Therefore, it is necessary to pay attention to the development of students' psychological, mental, emotional and social aspects.

Social development is related to students' perceptions, relationships with others, empathy and support for others. This ability can be enhanced in middle childhood by having students learn skills related to social learning content, including habits, skills and behavioral attitudes (Bader, 2007, 127). In order for students to be able to interact skillfully with others in the school environment, they must develop confidence and move beyond the egocentric stage that is the main characteristic of this age group.

Teaching social communication skills to students of this age group can improve their ability to solve problems and achieve personal and academic success. It has been observed that students with certain social communication skills are usually able to attend meetings and empathize with others, while on the contrary, children lacking certain social communication skills can lead to failure in social life, as pointed out by Goleman when he pointed out that children lacking certain social communication skills feel depressed, hopeless, do not understand what is happening around them, and most of the time they also face academic problems (Katami and El Youcef, 2010, p.17).

1.1. The problem

When conducting an oral measurement of some social communication skills with a six-year-old student, we encountered a problem with his lack of comprehension of the sentences used in the measurement. This is due to the fact that the student is not yet able to understand language at this age. The problem with the study was the lack of measures to measure some social

communication skills of students aged 6 to 8 years. We noticed this when conducting research in Algerian libraries. Even when we found these measures, they often depended on the judgment of teachers or mothers and were criticized for their lack of objectivity. Therefore, we considered it necessary to develop a graphic measure of some social communication skills of primary school students, adapt it to the research sample, and perform a factor analysis on the measure to ensure that the theoretical structure of the measure corresponds to the data obtained in the Algerian context. In summary, the problem can be summarized as follows: What is the factor structure of the social communication skills measure using exploratory and confirmatory factor analysis?

2. Research Questions

- 1) What are the validity and reliability data of the social communication skills scale for primary school children?
- 2) What is the factor structure of the social communication skills scale using exploratory factor analysis?
- 3) What is the factor structure of the social communication skills scale using confirmatory factor analysis?

2.1. Aims of the study

The primary objective of the study is to explore the factor structure of the social communication skills scale through both exploratory and confirmatory factor analysis. The study's specific objectives are:

- 1) To verify the factor structure of the scale using exploratory factor analysis with principal components method and Kaiser's criterion.
- 2) To verify the factor structure of the scale using confirmatory factor analysis with goodness-of-fit indices.

2.2. Significance of the study

The importance of the current research is outlined as follows:

- 1) To identify the factors and dimensions that make up the concept of social communication, which may help to predict related variables and thus control these factors to improve social communication skills outcomes.
- 2) To provide a measure of social communication for primary school students in the Algerian context with adequate validity and reliability.
- 3) To provide a practical methodological framework for the use of exploratory and confirmatory factor analysis in the design of psychological and educational measurement instruments.

2.3. Scope of the study

- **Temporal field:** From October 2023 to February 2024.
- **Spatial field:** Some primary schools in the province of Touggourt.
- **Human sphere:** The sample consists of 370 primary school pupils.
- The study is limited to the primary school age group (6-8 years).

2.4. The definitions of the key terms used in the study

- **Factor structure:** is defined as the different approaches that offer the required evidence of the alignment of the test elements with the conceptual framework of the ability components being evaluated (El Mahrazie, 2014, 88). It represents a form of construct validity achieved through factor analysis.
- **Social communication skills:** A collection of information, actions, and feelings that lead to suitable interactions with others. In this study, it is specifically defined as the score received by the student on the pictorial social communication skills scale.
- **Exploratory Factor Analysis:** A statistical method utilized to analyze the internal structure of tests and scales by extracting fewer factors than originally hypothesized.
- **Confirmatory factor analysis:** A method in statistics utilized to analyze the proposed factor configuration and confirm its compatibility with the observed structure derived from the research dataset.

3. The theoretical framework and previous studies

The data collection process is a crucial initial stage in all scientific research, necessitating the presence of a measuring instrument, which is a key requirement irrespective of the research type. Accuracy and consistency are the core foundations underlying measuring instruments, receiving paramount emphasis to ensure research findings are garnered with significant confidence and accuracy.

Factor analysis is essential for assessing the validity of measurement instruments. It is a multivariate statistical technique commonly employed to analyze data, correlation, or covariance matrices of variables and their interactions (Dimitrov, 2012, 69). Factor analysis is a multivariate statistical method that identifies relationships among variables by generating new variables, known as factors, which are fewer in quantity than the original set of variables (Allam, 2013, 238).

Factor analysis fulfills a variety of roles and functions that can be condensed into two primary roles or functions (Tigheza, 2012, 20).

- Condensing numerous measured variables or indicators into a limited number of latent variables that encapsulate them.

- Unveiling the fundamental factor framework, or the shared dimensions of significance that underlie the array of measured variables.

After selecting the factor analysis method and applying it to the data, It is essential to identify the appropriate number of factors to extract. The degree to which we choose to retain factors influences the amount of variance explained by them. Selecting the right number of factors is not a simple task. Various guidelines have been suggested by researchers to address this issue, with one common approach being the Kaiser-Guttman criterion. This criterion involves evaluating the Self-worths and keeping those that exceed 1.0 (Allam, 2013, 238). Cattell's scree test, a procedure aligned on the eigenvalues also exists. Gorsuch favors the scree test over the Kaiser Criterion, where he sees it to be more powerful when sample size is large and communalities are high (Tigheza, 2012, 50).

In the present study, we performed factor analysis to identify factors representing the measure of social communication skills used in examination, and then tested that whether or not our hypothesised model is validated by data collected from all students. In this section we explain some definitions of social communication and its measurements.

A definition of social communication skills offered by "Rimm Markle" was "the set behaviors containing either verbal or nonverbal expressions that one uses to manipulate how others act in personal contexts, so as a result achieve sought after outcomes while evade any unwanted ones" (Faraj, 2003,42).

Selts et al. They define social communication skills as "all kinds of communicative competence which individuals and groups need in order to interact with others appropriately collectively" (El Humaidi, 2004, 58).

From last definitions we are able to get a definition here in our study as this: the ability to process social situation cognitively and make socially reasonable behavior with others, easily communicate them, smoothly communicate with them and share emotionally among each other.

The present scale was developed partly from these and other useful scales, some of which are measures used to evaluate students' social communication skills.

* The last scale a pictorial one, is the katami and el youcef (2012) about social intelligence: It includes twenty illustrative situations questionnaire divided into four axes empathy; good communication skills; keeping

positive relationships with other staff in school; assert Equals between members of society. (Katami and El Youcef, 2010, 375)

* The Rehab El Sayed Social Skills Pictorial Scale: It includes (16) pictorial situations classified into three grounds (Cooperation – Love & Respect). (El Sayed, 2005, 149)

* Adel Abdullah Mohamed Social Scale for Child Interaction: which consists of (22) items and divided to three factors; social approach, social interest and social communication. (Mohamed, 2003, 10)

4. The previous studies

1- The study by (Grove et al., 2019): entitled “The factor structure of the social communication questionnaire in preschool children with autism spectrum disorder”.

The purpose of this study was to explore the factor structure of Social Communication Questionnaire in preschool children with Autism Spectrum Disorder. The Social Communication Questionnaire was completed for a group of 294 preschool children with Autism Spectrum Disorder, and confirmatory factor analysis was performed to estimate the fit of its structural model. Although the study did not reveal a direct fit to any of heads in DSM-5, it suggested further research should be conducted by examining factor analyses within other samples of children with autism spectrum disorder before estimating its due place as a screening tool.

2- The study by El Omari, Hasan Ghazi (2013): entitled “Indicators of reliability and criterion-related validity of the social skills inventory scale on jordanian samples”:

This research aimed to analyze the psychometric properties of a proposed Jordanian adaptation of the Social Skills Inventory Scale for students, originally developed by Inderbitzen and Foster (1992). The study involved 908 first-year university students. Results indicated strong consistency coefficients utilizing Cronbach’s alpha and by assessing item correlations with the total scores of both positive and negative scales within the original measure. Additionally, this research offered essential insights into the scale's convergent and discriminant validity through comparison to three established criteria: The Life Satisfaction Scale, the Clinical Anger Scale, and the Extraversion and Neuroticism Scale. Furthermore, factor analysis of the inventory yielded two factors, further affirming its validity. Finally, examining the association between positive and negative components of the scale provided further validation evidence.

3- The study by Habib, Ali Taher and El Kinani, Aayed Kareem (2011): entitled “Factorial validity of the psychological fluency scale for first division volleyball players in Iraq”:

The study aimed to assess the factor validity of the Psychological Fluency Scale and ascertain its levels among volleyball players. The researchers utilized a scale comprising 72 items across six categories: self-confidence, attention focus, anxiety confrontation, enjoyment, sport control and mastery, and performance mechanism. Following factor analysis, six factors were identified, resulting in a final scale of 38 items. The overall sample demonstrated an average level of psychological fluency, with all domains, except for enjoyment, falling within average levels, showing a high level of enjoyment.

5. Research Methodology

The present study employed descriptive research methodology to identify the components of social communication through exploratory factor analysis. This method seeks to streamline the factors into a more concise set. Additionally, the study utilized confirmatory factor analysis to assess and refine the proposed model by comparing it with the data-driven model from the study sample.

6. Study population and sample

The study population comprises all primary school students enrolled in Touggourt for the academic year 2023/2024, totaling 19,536 students as of 01/03/2024, based on data from the school card office of the directorate of education for Touggourt. To ensure result objectivity, three educational districts were randomly chosen from Touggourt, followed by the random selection of four schools from each district. The study sample included 370 male and female students.

Table 1. istribution of Study Sample by Education Districts.

Educational District	Total Number of Students	Study Sample
Touggourt 1	1483	60
Touggourt 2	1220	52
Touggourt 6	1427	68
Touggourt 7	2052	70
Maqarin	1563	59
Tayyibat 2	884	61
Total	8629	370

(Source: School Map Library of the Wilaya of Touggourt)

A sample of 50 students was used to calculate validity and reliability, while exploratory factor analysis was performed on a sample of 150 students, and confirmatory factor analysis was done on a sample of 170 students.

7. Study tool

Due to the absence of Algerian scales suitable for the current study, we utilized the social skills scale developed by Legougui (2015), which comprises three dimensions. Upon evaluation, we opted to exclude the empathic participation dimension, as it does not align with the behavioral aspects of social communication. Therefore, the scale now encompasses two dimensions.

- **Social interaction dimension:** consists of items 01,02,03,05,06,08,10,12.
- **Cooperation dimension:** consisting of items 04,07,09,11,13.

The scale creator illustrated actual situations to represent the items, with a total of 13 scenarios for boys and 13 for girls. Each scenario includes four pictures: the first portrays the problem, asking the child how they would respond, while the other three show possible solutions from which the child can choose to address the issue. The scale instructions were written in a simple language comprehensible to the child. A three-point rating scale was used (3 points: the child is able in such a situation, 2 points: partly able in this and 1 point not at all). So the score can be anywhere between 13-39.

8. Statistical method

To address the first question about the scale's validity and reliability, Pearson's correlation coefficient was employed to check convergent validity. Internal consistency was evaluated through cronbach's alpha coefficient, while split-half reliability was assessed using the Spearman-Brown formula. For the second question, an exploratory factor analysis was conducted using SPSS v26. To tackle the third question, confirmatory factor analysis was executed using AMOS v22.

9. Presentation of study results and discussion

9.1. Presentation of the answer to the first question

The first question is: What are the validity and reliability metrics for the social communication scale designed for primary school children? The scale's validity was examined through internal consistency and convergent validity.

Internal consistency validity

A key aspect of construct validity is assessing the correlation between each dimension and the overall score of the scale. Pearson's

correlation coefficient was employed to evaluate the relationship between each dimension and the total score of the scale. The results are presented.

Table 2. Showing the correlation coefficients between the dimensions and the total score of the scale .

Dimension	Correlation Coefficient with the Total Score
Social Interaction	0.895
Cooperation	0.764

Based on the coefficients obtained from the correlations between the dimensions and the total score of the scale, it is evident that these values are high, thereby confirming the scale's validity.

Convergent validity: Pertains to the extent of agreement between different measures that assess the same trait (Dimitrov, 2012, p. 48). This is indicated by a high positive correlation between scores from the trait being studied and scores from tests measuring similar traits (El Nabhan, 2013, p. 362). In the present study, the social communication scale was compared with the social interaction scale from Adel Abdallah Mohammed's research (2011) using a sample of 50 students. The correlation between these measures was determined using Pearson's coefficient, with the results presented in Table 3.

Table 3. Convergent Validity Indicators of the Study Instrument.

Criterion Measure	Correlation Coefficient
Social Interactions Scale	0.59

The table indicates that the calculated correlation coefficient was 0.59, which is considered a satisfactory value and a significant indicator of the convergent validity of the social communication scale being examined.

Reliability indicator

The reliability of the scale scores and their internal consistency were assessed using split-half reliability. Table 4 presents the split-half reliability coefficients for each dimension of the scale.

Table 4. Split-Half Reliability Coefficients by Scale Dimensions

Dimension	Split-Half Reliability Coefficient
Social Interaction	0.81
Cooperation	0.76

The stratified alpha coefficient is determined using the following formula:

$$\alpha_s = 1 - \frac{\sum(1 - \alpha_k)VAR(X_k)}{VAR(X)}$$

The reliability of the scale scores was assessed using the Stratified Alpha coefficient, and the variance of each dimension along with the total scale variance was utilized in the calculation (Dimitrov, 2012). The calculated stratified alpha reliability coefficient for the scale scores was 0.75.

From the results of the first question, it can be concluded that the social communication scale for students in the initial stage of primary education demonstrates acceptable validity and reliability indicators.

9.2. Presentation of the results of the second question:

The second question investigates whether the factor structure of the Social Communication Scale for Pupils is established using exploratory factor analysis. To address this, exploratory factor analysis was conducted to determine the construct validity of the scale. This method was deemed the most suitable for identifying the factors or dimensions that constitute the scale. Prior to performing the exploratory factor analysis, the suitability of the data for factor analysis was verified using the Kolmogorov-Smirnov test. The following table presents the values for the normal distribution verification.

Table 5. Normal distribution test values

Kolmogorov-Smirnov			Shapiro-Wilk		
Value	Degrees of Freedom	Significance Level	Value	Degrees of Freedom	Significance Level
0.035	150	0.200	0.990	150	0.066

The table indicates that the significance levels of the two tests were 0.200 and 0.066, both of which are greater than 0.05, leading to the conclusion that the data follow a normal distribution.

The adequacy of the sample size for conducting factor analysis was confirmed by the Kaiser-Meyer-Olkin measure, which had a value of 0.84, surpassing the threshold of 0.50. Additionally, Bartlett's test of sphericity yielded a chi-square value of 2836.82 with a significance level of 0.000, indicating statistical significance and confirming the suitability of the sample data for factor analysis.

The value of 0.40 was determined as the minimum to accept saturations of items on the dimensions. Hair and others believe that when focusing on practical benefit, saturation of 0.30 represents the minimum, while 0.40 is considered important, and that 0.50 is practically useful and applicable (Tigzah, 2012, p. 77).

Exploratory factor analysis was conducted using the principal axis factoring method with promax (oblique) rotation. The results revealed two factors that explained 64.63% of the total variance. The first factor had an Self-worth of 4.677 and accounted for 52.933% of the variance. This factor, named the “Social Interaction” factor, was loaded by eight items (01, 02, 03, 05, 06, 08, 10, 12) with loadings ranging from 0.69 to 0.84, encompassing items related to the social interactions between the child and their peers.

Table 6. Shows the matrix of the extracted variables (items) after rotation for the Social Interaction factor.

Item	Saturation
Item 01	0.812
Item 02	0.785
Item 03	0.725
Item 05	0.846
Item 06	0.801
Item 08	0.736
Item 10	0.698
Item 12	0.701
Self-worth	677.4
Variance Percentage	933.52%

The second factor had an Self-worth of 2.694 and explained 11.701% of the variance. It was loaded by five items (04, 07, 09, 11, 13) with loadings ranging from 0.76 to 0.87. This factor included items related to cooperation with peers, respecting roles, and helping others, and was therefore named the “Cooperation” factor.

Table 7. Shows the matrix of the extracted variables (items) after rotation for the Cooperation factor.

Item	Saturation
Item 04	0.879
Item 07	0.769
Item 09	0.843
Item 11	0.823

Item 13	0.787
Self-worth	694.2
Variance Percentage	701.11%

9.3. The results of the analysis for the third question are presented as follows:

The third question asks: What is the factor structure of the social communication scale using confirmatory factor analysis? based on the results of the exploratory factor analysis utilizing the principal components method, the social communication scale comprised two factors: the first factor, "social interaction," and the second factor, "cooperation."

To evaluate the statistical fit between the two-factor model and the data obtained from the current study sample, confirmatory factor analysis was conducted using AMOS v22. The fit indices commonly used by researchers in the field of structural equation modeling were employed to ensure alignment between the hypothesized structure and the reality derived from the sample data. These goodness-of-fit indices are as follows:

- The root mean square error of approximation is regarded as one of the best fit indices. Research has demonstrated its superiority and good performance. values below 0.05 indicate a good fit, values between 0.05 and 0.08 indicate a reasonable error of approximation in the population, values between 0.08 and 0.10 suggest an inadequate fit, and values above 0.10 indicate a poor fit (Tigzah, 2012, p. 230). Regarding the confidence interval around it, Gorsuch and Sorbom suggested that the cut-off value for this indicator should be less than 0.05 (Byrne, 2010, p. 81).
- The comparative fit index is a commonly employed metric for assessing model fit, encompassing a range of values from 0 to 1, where a score of 1 signifies optimal fit (Kline, 2016, p. 276).
- The index of goodness-of-fit is a measure that indicates the extent to which the model accounts for the variance. Typically, a value exceeding 0.90 is deemed satisfactory (Dimitrov, 2012, p. 105).
- The standardized root mean square residual is a crucial goodness-of-fit index. a value close to zero indicates a perfect fit of the hypothesized model, whereas higher values indicate a poorer fit. values below 0.1 generally suggest a good fit (Tighza, 2012, p. 234).
- The Tucker-Lewis Index is a non-normalized fit index that compares the hypothesized model to a baseline (independent or null) model. Similar to the Comparative Fit Index, Lewis Index values greater than 0.90 indicate a

reasonably good fit of the research or hypothesized model (Tighza, 2012, p. 232).

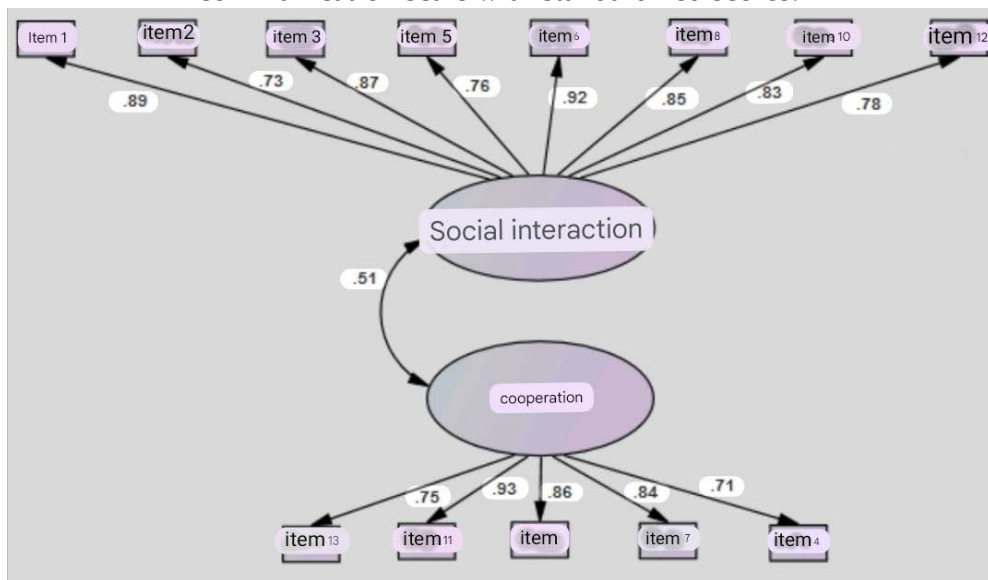
- Chi-square (χ^2) is widely recognized as a measure of goodness of fit. A statistically significant χ^2 value indicates that the hypothesized model differs from the sample data, whereas a non-significant χ^2 value often the goal of researchers suggests no significant difference between the hypothesized model and the sample data. However, χ^2 has several limitations, and it is recommended to complement its use with other goodness-of-fit indices (Tighza, 2012, p. 233).

- The Akaike Information Criterion and the Expected Cross-Validation Index are utilized for comparing two models. The model with the lower value of these criteria is generally considered to be the better fitting model.

Table 8. Shows the goodness of fit indices and their benchmarks.

Tucker-Lewis Index	Root Mean Square Error of Approximation	Comparative Fit Index	Root Mean Square Residual	Goodness of Fit Index	Chi-Square Probability Ratio	Index
0.94	0.03	0.95	0.06	0.93	0.02	Indicator value
≥ 0.95 acceptable	< 0.05 good	≥ 0.95 acceptable	≤ 0.08 acceptable	Values close to 0.95 are good agreement	> 0.05 fit < 0.05 no fit	Fit Quality Criteria

Figure 1. Results of a confirmatory factor analysis of the social communication scale with standardized scores.



The results of the confirmatory factor analysis provided strong support for the two-factor model. Specifically, the chi-squared value was 147.093 with 113 degrees of freedom, yielding a statistically significant p-value of 0.022. The Comparative Fit Index value was 0.951, indicating a high level of fit between the hypothesized model and the sample data. The Root Mean Square Error of Approximation was 0.037, suggesting a reasonable error of approximation in the population. The Tucker-Lewis Index was 0.949, reflecting a good fit, and the Standardized Root Mean Square Residual was 0.064, indicating a good fit as well. The Goodness of Fit Index was 0.931, further supporting the adequacy of the model.

These indices collectively indicate that the social communication model fits well with the data collected from the study population of primary school children. This alignment between the theoretical model of social

communication and the empirical data underscores the construct validity of the social communication scale. Confirmatory factor analysis has provided robust evidence supporting the validity and reliability of the scale in measuring social communication among this demographic.

10. Conclusion

The results showed that the Social Communication Scale for Primary School Students has acceptable validity and reliability. Two factors, “social Interaction” and “cooperation”, were identified through exploratory factor analysis. Confirmatory factor analysis further confirmed this two-factor structure, with all items having high factor loadings on their respective latent factors, thus supporting the construct validity of the scale.

Based on these findings, it can be concluded that the Social Communication Scale in its current form is suitable for use in the Algerian context. However, it is recommended that further research be conducted and that the scale be validated by applying it to similar samples of primary and preparatory schools. Such further validation would increase confidence in the applicability and reliability of the scale in different educational settings in Algeria.

Recommendations of the study

Based on the conclusions drawn from the study, the following recommendations are proposed:

- Incorporate the scale into future research to conduct more comprehensive studies on social communication and its connections to other pertinent variables.
- Utilize more exact and rigorous evidence to assess the reliability and validity of scales and tests, employing methods like factor analysis, hierarchical alpha, McDonald’s omega, convergent validity, discriminant validity, and composite reliability.
- Utilize the advanced statistical technique of structural equation modeling to examine the factor structure of scales and tests, thus assessing the validity of the proposed network of relationships within the model.

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