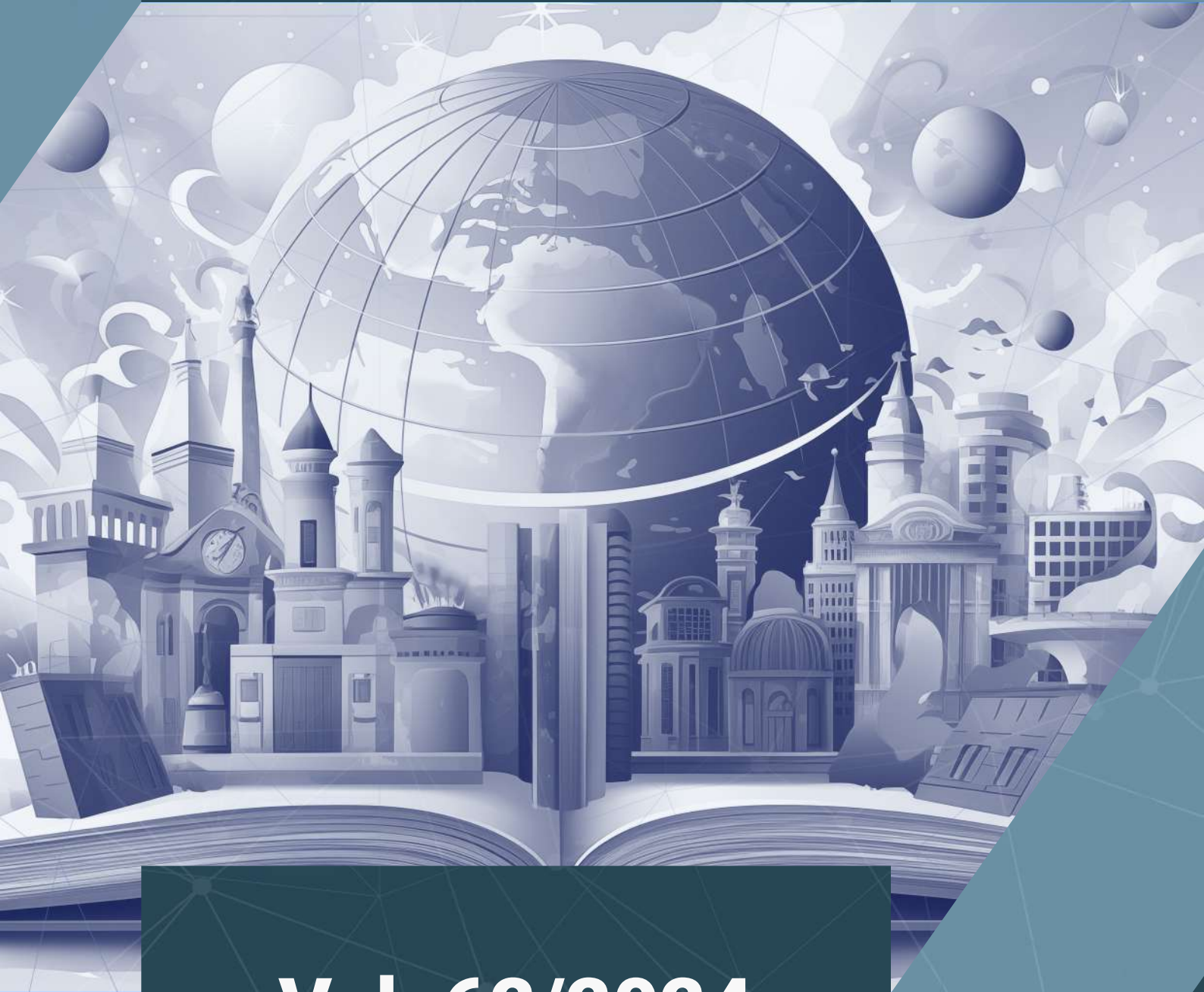




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Congruences of factor solutions of quantitative indicators for understanding the written form of deaf children's communication through the use of words types

Naim Salkić¹, Meliha Powlakić Hadžiefendić²

¹University of Sarajevo - Faculty of Health Studies, Bosnia and Herzegovina, ²Center for Hearing and Speech Rehabilitation Sarajevo, Bosnia and Herzegovina

salkicnaim@yahoo.com¹, melihapowlakic@hotmail.com²

Abstract. In deaf students, there is no contextual understanding and recognition of word types through linguistic competence testing compared to the hearing population, because 67.10% do not understand, and 10.00% of deaf respondents partially understand the contextual application of word types in a written text task. In written communication, deaf students use nouns (65.70%), pronouns (34.30%), verbs (45.7%), adjectives (28.60%), adverbs (22.90%), prepositions (54.30%), exclamations (15.70%), particles (12.90%) and numbers (32.90%). The aim of the study was to examine the factor solutions of quantitative indicators of contextual understanding of the word's types used and the relation of isolated factors of the words types words in the written text task of deaf students. The study was conducted on a sample of 140 respondents. The first subsample of respondents, the experimental group consisted of 70 deaf students, and the second subsample, the control group of 70 hearing students, of the same chronological age and gender. The measurement instrument "Test of comprehension of the written form of expression" was applied. The collected data were processed using the method of oblique rotation and the method of factor analysis. The results of the study showed that the language discourse of the deaf in the quantitative use of word types in the written form of expression is organized significantly differently compared to the hearing population. By factor analysis, three main factors were isolated in the deaf population, and four main factors were isolated in the hearing population. Considering the saturation of variability, it is possible to accurately determine in practice the direction of teaching deaf children the types of words in their native language. Isolated factors are part of separate, statistically unrelated entities in both deaf and hearing respondents and confirm the justification of successive teaching of the deaf respondents according to the types of words that are present in the comparative analysis of hearing respondents.

Keywords. deaf students, types of words, written form of communication

1. Introduction

Linguistic competence or language knowledge implies knowledge of the units of the language system at all levels: phonological, morphological, lexical, syntactic, semantic and textual level, and knowledge of the rules for combining language units and organizing them into higher order units (Jelaska, 2007). Language competences are linguistic and communicative competences. Linguistic competence includes theoretical knowledge about

language, and communicative competence includes practical knowledge of language, that is, practical use of theoretical knowledge (Aladrović, 2007). Due to the impossibility of converting the internal speech scheme into an expressive speech expression in mutual written communication, deaf children maximally use abbreviated speech schemes that determine their communication ability. The majority of deaf children (82.14 %) have written communication competence, they understand messages and respond adequately to the written content in accordance with the topic, but the majority of deaf children (75.58 %) do not have linguistic competence. Agrammatic sentence structures, the presence of omissions, substitutions and lexical inversions reduce the linguistic competence in the written form of communication of deaf children. About 24.42% of deaf children have linguistic competence in written communication. In written correspondence, the comprehensibility of short sentences consisting of two or three words is present. Deaf children use language idioms in their written communication, which they learn and use without any problems. Well-placed lexemes are present in the content of the sentences (Salkić, Hasanbegović and Švraka, 2018). Deaf children can use dialogue in written communication, but in most cases, they use sentences that are not linguistically correct. Poorer in writing complex sentences, but able to use complex sentences. Over 17% of deaf children can use syntactically correct complex sentences in written communication. Deaf children understand messages in written form of communication, they have communicative but not linguistic competence (Salkić, Hasanbegović and Švraka 2019). With deaf students, there is no contextual understanding and recognition of word types through linguistic competence testing compared to the hearing population, because 67.10% do not understand, and 10.00% of deaf respondents partially understand the contextual application of word types in a written text task. In written communication, deaf students use nouns (65.70%), pronouns (34.30%), verbs (45.7%), adjectives (28.60%), adverbs (22.90%), prepositions (54.30%), exclamations (15.70%), words (12.90%) and numbers (32.90%) (Salkić, Mahmutović, 2023).

The aim of the study was to examine the factor solutions of quantitative indicators of contextual understanding of the types of words used and the connection of isolated factors of the use of words types in the written text task of deaf students.

2. Methods

2.1. Sample

The study was conducted on a sample of 140 respondents. The total sample of respondents consisted of two subsamples. The first subsample of respondents (N=70), or the experimental group, consisted of deaf students chronologically aged from 10 to 18, who attend primary and secondary schools in educational and rehabilitation centers in Sarajevo, Tuzla and Banja Luka. The second subsample of respondents (N=70), the control group consisted of hearing students of the same chronological age and gender, selected by random selection from the population of hearing students.

2.2. Measuring instrument and method of conducting study

The vocabulary used by deaf children in their letters was used for the construction of a measuring instrument for assessing the linguistic competence of the written form of communication of deaf children (Salkić, Hasanbegović and Švraka, 2018. Content analysis of the written communication from of deaf children). The constructed test "*Test of understanding the written form of expression*" was modulated in such a manner that pictures were not described as suggested by Vladislavljević (1993), but based on the frequency representation of vocabulary in deaf children, a "text" was constructed, not a "comic" story for assessment of semantic levels

of written communication of deaf children. For adequate measurement in the data processing process, the text was constructed in such a way that each of the used types of words was numerically represented in a quantitative sequence. The study was conducted in such a manner that the respondents did not know that they were in an experimental situation, and it was organized in such a way as to simulate a regular school knowledge test in order to achieve the interest and motivation of students in the research process. The applied variables of the measuring instrument are: *Number of properly used nouns; Number of properly used pronouns; Number of properly used verbs; Number of properly used adjectives; Number of properly used adverbs; Number of properly used prepositions; Number of properly used exclamation points; Number of properly used particles and Number of properly used numbers*. Examination of conjunctions as a type of word was not done in this research, because the text task was constructed in such a manner that the conjunctions in the task were a guide for recognizing other types of words and writing them on the empty lines to make it easier for the respondents to complete the tasks.

2.3. Data processing methods

Collected research data for the examination of factorial solutions and the connection of isolated factors, in the correct use of word types between deaf and hearing respondents, were processed by the method of oblique rotation and the method of factor analysis.

3. Results and discussion

3.1. Factor analysis in the manifest space of applied variables

In the paper "*Quantitative understanding of the written form of communication of deaf children through the use of word types*" (Salkić, Mahmutović, 2023) through frequency analysis, a quantitative analysis of the use of word types in the contextual part of the given text material was performed, and a comparative analysis of two subsamples of respondents was performed, as it would be established whether there are and how big the differences are between deaf and hearing respondents in terms of the quantitative use of word types in the text. It was found that out of a total of 70 deaf respondents, 10% of the deaf respondents understand and recognize the written form of expression in relation to the observed types of words, and 98.60% of the hearing respondents understand and recognize the observed types of words in the text task in response to the contextual characteristics of the story. It was also established that 67.10% of the deaf respondents were not able to recognize and understand the contextual use of the observed types of words in the written form of the text task, in contrast to the deaf, where there is no respondent who does not understand the contextual use of the types of words in the written text task. Deaf respondents partially understand and recognize the contextual use of word types in a written text task in 22.90% of cases, in contrast to hearing respondents who partially understand the contextual use of word types in a written text task in 1.40% of cases. Based on the comparative analysis, it was found that deaf children did not adequately answer the task, and the results of the t-test showed the existence of statistically significant differences between deaf and hearing respondents on all types of words except verbs.

Considering the fact that there was no statistically significant difference between deaf and hearing respondents in the use of verb forms, it is concluded that there are connections between these types of words and other types of words that can have qualitative solutions in teaching deaf literacy, and based on these of information approached the congruent solution of matching the use of word types using the oblique rotation method, in order to reach the saturation of latent information that may have implications in revealing the gradualness of

teaching deaf children to word types. The determinant was calculated for the experimental and control group of respondents, which is 0.086 for the deaf population and 0.157 for the hearing population. Given that the determinant is not less than or equal to zero, it represents the information that the data matrices are suitable for the factorial implementation of the obtained solutions, and that the ratio of the applied space of variables is adequate to the sampled research model.

Table 1. Statistical significance of reliability and representativeness of applied variables

KMO and Bartlett's test		Deaf respondents	Hearing respondents
Kaiser-Meyer-Olkin measurement for adequate reliability		0.67	0.56
Bartlett's test	H ²	159.53	120.69
	df	36	36
	p	0.000	0.000

Table 1 shows a comparative presentation of the reliability and representativeness of the measurement using the respondent variables tested with the proposed levels of coefficients expressed in z-values, proposed by the authors Kaiser-Meyer-Olkin, which in this measurement are relatively high, that is, in the range from 0.55 to 0.65. The test of statistical significance was calculated by Bartlett's test with the help of the H² test and in this measurement, it is 159.53 and 120.69, at the level of statistical significance of p=0.000 for both samples of respondents. After determining the reliability of the variables for the application of factor solutions in order to summarize information and condense the variables into logically connected latent solutions of the applied system of variables, an insight was made into the communalities of the experimental and control group of variables which, through their coefficients of z values, saturations from the initial initial form, by the solution of a real number converted into variable relations of each individual variable with the total variability of the entire system.

Table 2. Communalities of the applied variables of the subsample of respondents

Variables	Deaf respondents		Hearing respondents	
	Initial	Extraction	Initial	Extraction
Properly used nouns	1.000	0.697	1.000	0.706
Properly used pronouns	1.000	0.536	1.000	0.436
Properly used verbs	1.000	0.558	1.000	0.647
Properly used adjectives	1.000	0.754	1.000	0.920
Properly used adverbs	1.000	0.602	1.000	0.583
Properly used prepositions	1.000	0.706	1.000	0.656
Properly used exclamation points	1.000	0.811	1.000	0.746
Properly used particles	1.000	0.618	1.000	0.833
Properly used numbers	1.000	0.516	1.000	0.696

By looking at Table 2, the communalities of each individual variable can be observed, and the size of the relation with the total variability of both the experimental and control groups can be determined. The greatest communalities among the deaf population were realized in the types of words used: exclamations, prepositions and adjectives, while the greatest communalities among the hearing population were achieved by variables: adjectives, particles,

exclamations and nouns. *Given that communalities are relatively high compared to the entire system, it is necessary to look into the latent space of variability and establish what percentage of variability has the saturation of common interactions in the use of word types, which is extremely important in any language.*

Table 3. Latent space of the subsample of respondents isolated by the total percentage in common variability

Components	Deaf respondents			Hearing respondents		
	Lambda	% variances	Cumulative variance	Lambda	% variances	Cumulative variance
1.	3.009	33.43	33.43	2.564	28.49	28.49
2.	1.448	16.08	49.52	1.533	17.03	45.52
3.	1.342	14.91	64.43	1.106	12.29	57.81
4.	0.852	9.47	73.90	1.020	11.33	69.14
5.	0.727	8.08	81.98	0.870	9.66	78.80
6.	0.520	5.78	87.75	0.693	7.70	86.59
7.	0.483	5.37	93.12	0.500	5.56	92.07
8.	0.338	3.75	96.87	0.457	5.08	97.15
9.	0.282	3.13	100.00	0.257	2.85	100.00

Table 3 shows the latent space of the subsample of respondents isolated by the total percentage of shared variability. The percentage of common variability was extracted by the directoblmin solution, which is oblique rotating solutions of the manifest data matrix using the method of component analysis. This method of extracting the main components takes as much variability as possible, which by rotation performs a kind of blinding of the manifest quantitative values of the variables to a saturation level of unity or greater than the variability unit. *In the case of deaf respondents*, the saturation of variability identified three main components, which are ranked in order of importance according to the logic of the method and variability. In the first isolated component in deaf respondents, 33.43% of the common variability was extracted, the coefficient of which is 3.009 variance. In the second isolated component, 16.08% of the common variability was extracted with a coefficient of 1.448, and in the third isolated component, 14.91% of the common variability was extracted with a coefficient of 1.342. After the third isolated principal component, whose total variability is 1.342, the other components are overwritten by measurement errors and other unknown factors. The total variability of the isolated components is 64.43%, which represents enough variability for scientific conclusions.

In contrast to the deaf population, *in the hearing population, four main components with a total variability of 69.14% were extracted using an identical extraction method.* The isolated components represent the information that the language discourse is organized significantly differently by the use of quantitative sizes of word types in the test material than in the deaf population, and it is necessary to gain insight into the content relationships of the isolated main components of both subsamples of respondents in order to be able to make a comparison and determine the hierarchical structure of binding the type of word in the contextual relations of the written form of expression.

Table 4. Parallel projections of variables extracted by the method of component analysis

Variables	Components of deaf respondents			Variables	Components of hearing respondents			
	1	2	3		1	2	3	4
Properly used VERBS	0.723			Properly used NOUNS	0.834			
Properly used PREPOSITION	0.714			Properly used PREPOSITION	0.778			
Properly used NUMBERS	0.680			Properly used VERBS	0.618			
Properly used NOUNS	0.637			Properly used PRONOUNS	0.379			
Properly used ADJECTIVES		-0.838		Properly used EXCLAMATIONS		0.724		
Properly used ADVERBS		-0.770		Properly used ADVERBS		0.643		
Properly used EXCLAMATIONS			0.800	Properly used NUMBERS		0.594		
Properly used PARTICLES			0.747	Properly used PARTICLES			-0.917	
Properly used PRONOUNS			0.500	Properly used ADJECTIVES				0.959

Table 5. Orthogonal projections of variables extracted by the method of component analysis

Variables	Components of deaf respondents			Variables	Components of hearing respondents			
	1	2	3		1	2	3	4
Properly used PREPOSITIONS	0.778			Properly used NOUNS	0.805			
Properly used NUMBERS	0.707			Properly used PREPOSITIONS	0.767			
Properly used VERBS	0.678			Properly used VERBS	0.668			
Properly used NOUNS	0.664			Properly used PRONOUNS	0.451			
Properly used ADJECTIVES		-0.860		Properly used ADVERBS		0.693		
Properly used ADVERBS		-0.775		Properly used NUMBERS		0.639		
Properly used EXCLAMATIONS			0.818	Properly used EXCLAMATIONS		0.629		
Properly used PARTICLES			0.749	Properly used PARTICLES			-0.897	
Properly used PRONOUNS			0.560	Properly used ADJECTIVES				0.955

Based on the extraction of components in the applied method, insight was made into the parallel and orthogonal projections of the variables on the entire applied system of measuring the types of words in the measured material. Parallel projections provide information on

correlations, and orthogonal projections on variable saturations. *The component method showed that three main factors were isolated in the deaf, and four main factors in the hearing respondents (tables 4 and 5).*

Considering that the first main component contains the most saturation of variability, it provides the most information about the quantitative characteristics of the use of word types in the text task and their hierarchical order. By looking at the parallel projections, it can be stated that *in the first review of the measurements, the correct use of verbs, prepositions, numbers and nouns is represented by the size of the correlations.* These correlations are not in a logical relationship, because the use of verbs in the language is always related to the knowledge of the noun, that is, the performer of a certain action. Perhaps the result of this binding is the influence of the syntax of sign language, which first prefers the action, then the noun. Orthogonal projections show a slight change according to the saturation of the coefficients, and include the correct use of prepositions, numbers, verbs and nouns, which does not significantly change the structural relations in the application of word types by quantitative saturation in written communication.

In the second factor, which is negative, adjectives and adverbs are isolated. This component indicates the fact that the majority of deaf respondents are grouped by the amount of knowledge of this type of word with their negative correlations in relation to the first component in the performance of the task, and this information indicates that *deaf children are the least taught based on these types of words.*

The third component for which deaf children showed the least common saturations in variability are: exclamations, particles and pronouns.

In contrast to the deaf population, *four main factors stood out in the hearing population.* In the first factor, the variables correlated: nouns, prepositions, verbs and pronouns. These types of words are logical due to their saturation in each language, because they represent informative values of communication content, and orthogonal projections did not show any change after saturation, which represents the logical whole of the organization of writing using these types of words. In the second component, they correlated and saturated the variables: exclamations, adverbs and numbers, which in the hierarchical relationship of learning are also a secondary characteristic of word types, and have a justifying logic of this connection. In the third component, one type of word, particle, is isolated, and in the fourth, an adjective. *Considering such saturation of variability, it is possible to accurately determine in practice the direction of teaching deaf children the types of words in their native language. In order to justify this claim, it is necessary to examine the correlation of isolated components.*

Table 6. Correlation of isolated components of the matrix assembly

Components	Deaf respondents			Hearing respondents			
	1	2	3	1	2	3	4
1	1.000	- 0.177	0.147	1.000	0.129	- 0.098	0.012
2	- 0.177	1.000	- 0.102	0.129	1.000	- 0.121	0.065
3	0.147	- 0.102	1.000	- 0.098	- 0.121	1.000	- 0.075
4				0.012	0.065	- 0.075	1.000

Table 6 shows the correlation of isolated components, and by looking at the correlation coefficients, it can be concluded that the components are part of separate, statistically unrelated entities in both deaf and hearing respondents. *These results confirm the justification of the*

successive teaching of the deaf according to the types of words that are present in the comparative analysis of the hearing respondents, because the isolated components are part of the strategic planning of teaching and the use of the type of words in the language discourse.

Similar studies

In order to obtain a more complete representation of the content understanding of the written form of communication of deaf children, we cite some studies, opinions and conclusions of authors who dealt with similar issues.

When writing independently, hearing-impaired respondents, considering the type of word, mostly use nouns (51.61%), followed by verbs (23.32%), prepositions (8.10%), then adjectives (4.70%), pronouns (4.18%), and conjunctions (3.22%), numbers (1.91%), adverbs (1.65%) and particles (1.31%) (Huremović, 2009).

Deaf children have difficulty using pronouns, determiners, conjunctions, passives and conditional verbs such as: “may”, “can” and “should” (Wilbur, 2000).

The four main omissions in the written expression of deaf and hard of hearing children are: prepositions, objects, verbs (especially auxiliaries) and the strength of connections between words. In practice, deaf children who have mastered the phonological-morphological structure of the language can say and repeat a given sentence without understanding the meaning of the sentence and the message it carries, and have difficulty writing that sentence (Hasanbegović, 2009).

In speech, a deaf child usually uses only nouns and verbs, while omitting prepositions, pronouns and conjunctions. For him, significant parts of the sentence are represented by words that denote things, people and actions related to them (Kovačević, 2000).

Starting from previous and syntactic knowledge, the greatest importance in approaches to teaching reading to prelingually deaf people should be given to the building of syntactic and semantic abilities, regardless of the communication system and language that the child used as primary (Miller, 2000).

For deaf people to understand the read text, their ability to develop knowledge about the structure of the story and to use it correctly is very important (Schirmer, 2003).

4. Conclusions

The linguistic discourse of the deaf in the quantitative use of word types in the written form of expression is organized significantly differently compared to the hearing population.

Factor analysis in the deaf population isolated three main factors. In the first isolated factor, the hierarchical structure of tying types of words into the contextual relationships of the written form of expression goes in the direction of the correct use of verbs, prepositions, numbers and nouns. Orthogonal projections show a slight change towards the saturation of the coefficients, and include the correct use of prepositions, numbers, verbs and nouns. Another isolated factor shows a negative correlation between the correct use of adjectives and adverbs, indicating that deaf children are least taught these types of words. The third isolated factor goes in the direction of the correct use of exclamation points, particles and pronouns.

In the hearing population, four main factors were singled out. In the first factor, the hierarchical structure of tying types of words into the contextual relationships of the written form of expression goes in the direction of the correct use of nouns, prepositions, verbs and pronouns, and in the second, in the direction of the correct use of exclamation points, adverbs and numbers. Particles are isolated in the third factor, and adjectives in the fourth. Considering

such saturation of variability, it is possible to accurately determine in practice the direction of teaching deaf children the types of words in their native language.

Isolated factors are part of separate, statistically unrelated entities in both deaf and hearing respondents and confirm the justification of successive teaching of the deaf according to the types of words that are present in the comparative analysis of hearing respondents.

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