

CHAPTER 3

RESEARCH METHODOLOGY

3.1. INTRODUCTION

This chapter discusses the aims and objectives, research design, subjects, material and apparatus used as well as data-collection procedures in order to give the reader a clear understanding of the research process used in the study.

3.2. AIM AND SUB AIMS

3.2.1. Aim

The aim of this study was to investigate whether or not there were differences between the two symbol systems Blissymbols (Bliss) and CyberGlyphs (Glyphs) in terms of ease of learning and recognition.

3.2.2. Sub aims

The objectives of the study were:

- To identify **80** familiar concepts relevant for teaching, of which 40 are Blissymbols and 40 CyberGlyphs;
- To teach 40 Blissymbols and 40 Glyphs to Group 1 and Group 2 by means of an analytical approach;
- To compare the results of the two groups with reference to:
 - * the number of symbols correctly recognised after each training session
 - * the number of symbols correctly recognised after a period of withdrawal;

– To do a qualitative analysis of and comparison between Bliss and Glyphs to determine:

- * the association between word categories represented by the symbols (verbs, pronouns, etc.) and ease of learning and recognition.

3.3. RESEARCH DESIGN

A quasi-experimental crossover design between groups was carried out on two homogeneous groups of normal, Northern Sotho-speaking children. Inter-group comparisons could be made on the performance between Bliss and Glyphs across both groups. A within-group comparison was also made by comparing the performance of Bliss and Glyphs within one group. These comparisons were made to determine whether there were any significant differences between the ease of acquisition and retention of Bliss and Glyphs. Table IX provides a visual presentation of the design.

Table IX: Visual representation of the research design

GROUP 1		GROUP 2
40 Blissymbols (Bliss A)*	Inter-group comparison	40 CyberGlyphs (Glyphs A)*
↕	↔	↕
Within-group comparison		Within-group comparison
40 CyberGlyphs (Glyphs B)#	Inter-group comparison	40 Blissymbols (Bliss B)#
↕	↔	↕
Total number of concepts: 80		Total number of concepts: 80

* Same concepts as Glyphs A

Same concepts as Bliss B

3.4. SUBJECTS

Fifty regular students at a primary school in Mamelodi-West were selected according to the criteria for selection listed below in Table X. Information was obtained through interviews with the relevant teachers, and from school records. To facilitate inter-group comparisons, close attention had to be paid to the homogeneity of the two groups. The distribution of the subjects into two separate groups had to be as homogeneous as possible to ensure that the two groups were comparable. The characteristics mentioned in Table X were taken into consideration when the subjects were divided into Groups 1 and 2 by ensuring that age, academic level and gender were represented equally between the two groups.

According to Higginbotham (1995), the use of non-disabled populations could provide us with group level data on basic learning strategies and difficulties associated with a particular symbol system. We could also become aware of the underlying cognitive processes of symbol acquisition (Mizuko, 1987). Non-disabled populations have been used in Blissymbol studies by Mizuko (1987), Schlosser (1995) and Schlosser and Lloyd (1993). As the population using AAC is quite heterogeneous (Higginbotham & Bedrosian, 1995), a non-disabled population was chosen so that the homogeneity of the subjects could be more controlled. This provides the researcher with a better opportunity to investigate differences between the two symbol systems (i.e. Bliss and Glyphs).

3.4.1. Selection criteria

The selection criteria used to select the subjects in this study is listed in Table X.

Table X: Criteria and procedures used for subject selection

SELECTION CRITERIA	METHOD	MOTIVATION
Mother tongue: Northern Sotho (NS)	Information concerning the children's predominant language was obtained from the teachers.	Training took place in NS. It was selected as the language for this study because it is the native language spoken in the greater Pretoria area. Only NS as predominant language was acceptable, to ensure uniformity
Scholastic level: Grades 4, 5 & 6	The Grades 4, 5 & 6 teachers were consulted on the availability of students who complied with the other selection criteria.	Grades 4, 5 & 6 pupils were selected because they were able to read, which is a prerequisite for the evaluation procedure. The spread over the three year groups was to ensure a greater number of subjects to participate in the study.
Scholastic performance (cognitive abilities) – no academic year had to be repeated	The teachers' opinions on the cognitive abilities as well as school records on performance of the subjects were obtained	The inclusion of subjects with normal cognitive abilities enabled the researcher to compile two homogeneous groups of children so that a comparison between the two groups could be possible
Reading ability – appropriate for specific grade level of each subject	Information on reading ability was obtained from the teachers	Normal reading abilities were necessary since the students had to be able to read to participate in the testing procedure by reading paragraphs. They also had to grasp the meaning of the paragraph content to respond correctly to the training procedure.
No prior exposure to Bliss or Glyphs	Information was obtained from the teachers	Previous experience of Bliss or Glyphs could affect the reliability of the research results (Moolman, 1994). If the subject had prior exposure to either symbol system, his knowledge of the symbols might have influenced the percentage of symbols correctly identified.
Visual acuity	Information was obtained from the teachers as to whether the subjects wore glasses, had had eye operations or had problems seeing the blackboard.	This criterion was included as students were expected to recognise and discriminate between different symbols of Bliss and Glyphs. Students with visual problems were excluded as fine visual discrimination is necessary to distinguish symbols with minor differences from one another (Lane & Samples, 1981).
Normal hearing ability	A hearing-screening test was carried out on each subject with the use of a GSI 33 screening audiometer by an audiologist.	Normal hearing refers to hearing sensitivity between -10dB and 25dB (Bess & Humes, 1991). A pure-tone air-conduction threshold that falls within this parameter was accepted as normal hearing. In the case of this study, a cut-off point of 30dB was accepted, because the testing did not take place in a soundproof environment. Normal hearing is necessary in the implementation of the study as the students had to follow instructions aurally during the training of the symbols.

Table X: Continued

Same geographical area (Mamelodi-West)	All the subjects were selected from the same geographical area and attended the same school.	To ensure that the test population was as homogeneous as possible, the population was selected from the same geological area and school. This also ensured that the dialect of Northern Sotho was the same for all the subjects.
Gender	The subjects were selected so that there were an equal number of female and male subjects in each group.	This criterion was included to exclude any influence that gender might have on learning and retention of the symbols.
No obvious emotional problems	Information was obtained from the teachers.	Any problem concerning low self-esteem, demoralisation and defects in social skills may be associated with learning disorders (DSM/IV, 1994) and influence the process of learning.

3.4.2 Description of subjects

From a total of 193 pupils (65 pupils in grade 4, 66 in grade 5, and 62 in grade 6) sixty-seven complied with the selection criteria. From these pupils, 50 subjects were systematically selected for the main study. Random selection was not an option since the subjects had to be divided into two homogeneous groups and it was therefore necessary that the subjects had similar characteristics in both groups. From the 17 that remained, 12 subjects were used for the pilot study. Five were excluded to ensure that the pilot study groups were homogeneous and because their inclusion would have influenced the homogeneity of the pilot study group. The 50 subjects in the main study were divided into two groups of 25 each. Both groups had the same school performance average, mean scholastic level, similar mean age as well as the same number of male and female subjects in each group (see Table XI). The 50 subjects, comprising 24 pupils from grade 4, 12 pupils from grade 5 and 14 pupils from grade 6, were selected and the two groups were compiled with the same number of subjects in each group. The grade 4, 5 and 6 pupils were also divided equally between the two groups: Twelve grade 4 pupils, six grade 5 pupils and seven grade 6 pupils in Group 1; 12 grade 4 pupils, six grade 5 pupils and seven grade 6 pupils in Group 2. Although subjects were not paired between the two groups, it was ensured that the overall performance of one group could be compared with that of the other group by making sure that the groups were as

homogeneous as possible. In Table XI the number of subjects in the main study in the two groups are summarised according to age, gender, grade and scholastic performance.

Table XI: Age groups, scholastic levels and grades of the subjects selected

GROUP 1					GROUP 2				
SUBJECT NR.	SCHOOL PERFORM- MANCE	GENDER	AGE	GRADE	SUBJECT NR.	SCHOOL PERFORM- MANCE	GENDER	AGE	GRADE
1BG1	A-	F	9.9	4	2GB1	A+	M	9.4	4
1BG2	A+	M	10.1	4	2GB2	A-	F	10.2	4
1BG3	B+	M	9.6	4	2GB3	B+	M	10	4
1BG4	B+	F	9.8	4	2GB4	B-	F	10.6	4
1BG5	B-	F	9.4	4	2GB5	B-	M	9.5	4
1BG6	C+	F	10.4	4	2GB6	C+	M	9.6	4
1BG7	C+	M	10.2	4	2GB7	C+	F	10	4
1BG8	C-	M	9	4	2GB8	C+	F	10.2	4
1BG9	D+	F	11.2	4	2GB9	D+	M	10.10	4
1BG10	D+	M	11.4	4	2GB10	D+	F	9.4	4
1BG11	D+	F	9.5	4	2GB11	D+	F	9.8	4
1BG12	D+	M	9.7	4	2GB12	D+	M	9	4
1BG13	A-	F	12.11	5	2GB13	A-	F	10.7	5
1BG14	B+	F	10.7	5	2GB14	B+	M	10.9	5
1BG15	B-	M	10.9	5	2GB15	B-	M	10.7	5
1BG16	C-	M	11.2	5	2GB16	C+	F	11.5	5
1BG17	D+	F	10.6	5	2GB17	D-	F	12.1	5
1BG18	D+	F	11.5	5	2GB18	D+	M	11.2	5
1BG19	A-	M	12.9	6	2GB19	A-	F	11.2	6
1BG20	B-	F	11.10	6	2GB20	B-	M	12.8	6
1BG21	B-	F	12.10	6	2GB21	B+	F	11.7	6
1BG22	C+	M	11.5	6	2GB22	C+	M	11.10	6
1BG23	C+	F	11.7	6	2GB23	C-	F	12.3	6
1BG24	D+	M	12.11	6	2GB24	D+	F	11.4	6
1BG25	D+	M	11.9	6	2GB25	D+	M	12.6	6
MEAN %	C+	F =13 M=12	10.82	4.8		C+	F =13 M=12	10.88	4.8

BG = Bliss/Glyphs (Group 1)

F = Female

GB = Glyphs/Bliss (Group 2)

M = Male

From Table XI is clear that the groups were highly homogeneous in relation to age, gender and school performance.

3.4.3. Selection of trainer

3.4.3.1. Purpose

The fieldworker was selected on the basis that she is a teacher at the school and speaks the dialect of Northern Sotho spoken by the children at the school. She is also fluent in English. This enabled her to communicate effectively with the researcher as well as with the subjects. The fieldworker's highest educational qualification was a teaching diploma and her teaching and reading abilities were excellent. This was a necessary skill as it was required of the fieldworker to read accurately to the subjects the instructions and the descriptions of the symbols. This ensured that the training on the symbols did not differ for the two systems used and that the training was carried out accurately. She was also able to handle the two groups of 25 children well with regard to discipline and keeping their attention.

3.4.3.2. Training

The fieldworker was trained a day prior to the actual training of the pilot study group. She was involved in the translation of the training material and knew how each symbol should be explained. The following material was given to the fieldworker: Instructions before training; description of individual symbols; instructions before testing; instructions before testing after the withdrawal periods; the paragraphs to be used; as well as the pictures describing the symbols (See Appendices A – F). She had to read the descriptions from the prepared translation, without adding any additional information about the symbol. She could, however, add words of praise at the appropriate stages when the children responded correctly to questions, for example, by saying: "yes, very good". During the practice session, the teacher had to follow different training steps as presented in the written translation. This was done to determine whether she understood how the explaining of the symbols had to take place and to stress the importance of following the steps accurately. During the training session the fieldworker had to present the explanations to the researcher by reading from the script. This included the instructions that would be given to the children, as well as the explanation of the action indicators of both symbol systems and the adjective indicator in

Bliss. The researcher followed the script with the fieldworker, and a recording was made of the explanations and instructions. This was compared with the original script by the researcher after the fieldworker's training session. One of the Northern Sotho-speaking teachers who assisted with the translation of the scripts, helped with the analysis of the recordings. Any words, phrases or sentences that were not included in the original script were written down. Any phrases or information added or omitted was recorded. It was agreed that the fieldworker followed the script accurately and was able to present it to the subjects (see 3.11.1. for detailed discussion).

3.5. PILOT STUDY

Out of the 17 pupils who complied with the selection criteria, 12 children (four in each grade) were selected for the pilot study, and were consequently not included in the main study. The 80 concepts selected, as well as the four paragraphs compiled for the main study, were translated into Northern Sotho by six teachers from the school where the study was carried out, one of which was the fieldworker used during training. The aims of the pilot study as well as the methods used and results obtained are listed in Table XII.

Table XII: The aims, methods, results and recommendations of the pilot study

AIMS	METHOD	RESULTS
To ensure the accurate translation into Northern Sotho of the text used in the training session as well as the paragraphs used for training purposes	The translation of the paragraphs and instructions was discussed by the researcher with four teachers to ensure that the Northern Sotho translation was accurate. The teachers conferred about the most appropriate translation of the testing material.	The teachers agreed on the translation of the instructions, paragraphs and concepts. They conferred on some forms of the words used, as there was more than one acceptable word for some concepts e.g. "kiss" can be referred to as "atla" or "suna". In this case the last option was used more often by the children and was therefore selected as the appropriate translation for "kiss". Both options could not have been used, because this would have confused the children during the training session when the material was presented in paragraph form.

Table XII: Continued

<p>To determine whether the concepts used were culturally appropriate and familiar to the subjects</p>	<p>To determine if the children were familiar with the concepts, they all had to make sentences with each concept that was selected. The responses were given verbally and the four teachers determined whether the sentences were semantically correct. The teacher also translated the NS responses to the researcher.</p>	<p>The four teachers agreed that the subjects should all be familiar with the concepts used in the study because they were concepts commonly used by the community. All the pupils could compile semantically correct sentences with the given concepts, which proved that they did know the meaning of the concepts.</p>
<p>To train the fieldworker in the consistent presentation of symbols and explanations thereof</p>	<p>The fieldworker was familiar with the way in which the symbols should be explained, as she was involved in the translation of the descriptions. She had to read from the script without deviating from the written example. She read it to the three teachers who assisted her with the translation. They followed the reading from their given copies to ensure that the fieldworker did not deviate from the text, which would ensure that the presentation of the symbols did not differ in presentation. The reading was also recorded on a tape recorder. The symbols were then explained to the children in the pilot study groups by presenting the descriptions from the written script.</p>	<p>The presentation to the teachers proved that the fieldworker understood the importance of using the text without deviating. She managed to present the instructions and explanations according to the prescriptions. The other teachers agreed that the fieldworker read the script accurately and that the presentation was natural.</p>
<p>To determine whether the analytical or global training method should be used</p>	<p>The subjects in the pilot study were divided into four groups of three children each. The four groups were tested separately on the same day in the room used for the main study. Twenty of the 80 symbols (four from each word category) were taught to all the groups. Group 1 was taught 10 Bliss through the analytic approach by reading from the written translation. Group 2 was taught 10 Bliss by means of the global training approach. Group 3 was taught Glyphs by means of the analytic approach. Group 4 was taught Glyphs by means of the global approach</p>	<p>According to the pilot study, the analytical approach had a higher success rate and will therefore be used during the main study (see Table XIII for the results)</p>

Table XII: Continued

To determine the time it would take to train for the symbol with the analytical and global training approach	A stopwatch was used to time the presentations and the timer was started as soon as the training started for the last presentation	The analytical approach was more time consuming than the global approach (see Table XIII) but since the analytical approach had a better success rate, it was chosen as the method to be used in the main study.
To see whether the presentation of symbols maintained the interest and attention of the subjects during the training session.	The symbols were incorporated into paragraphs that covered topics the children would encounter in their daily life in order to contextualise the concepts taught.	The paragraphs and the group participation proved to be a successful way of maintaining the interest of the subjects.

Table XIII: A summary of the duration and percentages of the symbols correctly identified during the pilot study using the global and analytical approach

GROUPS	SYMBOL SYSTEM	TRAINING METHOD	DURATION OF TRAINING	SYMBOLS CORRECTLY IDENTIFIED
Group 1	Bliss	Analytical	16.25 minutes	75%
Group 2	Bliss	Global	11.50 minutes	55%
Group 3	Glyphs	Analytical	15.56 minutes	80%
Group 4	Glyphs	Global	11 minutes	65%

From Table XIII it was evident that there was a time difference of 4.35 minutes between the two Bliss groups and 4.56 minutes between the two Glyphs groups. It took less time to teach the symbols with the global approach than the analytical approach, because the latter took more time to explain each symbol. However, the analytical approach in both instances had a higher percentage of symbols correctly identified after a period of training. It was therefore useful to use the analytical teaching approach. In the study of Shepherd and Haaf (1995) it was found that subjects performed better when Blissymbols were trained by explaining the meanings of the individual components and contextualising the symbols, rather than just labelling the symbol.

Table XIV: The data-collection material used during the pre-training,

3.6. MAIN STUDY

The main study consisted of the pre-training phase, training phase and post-training phase. The pre-training phase entailed giving the instructions of the procedures to follow and familiarising the subjects with the testing procedure used during the training and post-training phases. The training phase included teaching the children the different symbols and evaluating their recognition of the symbols after every training session by letting them match the symbol with the relevant referent. Revision was also included in this phase. The post-training phase entailed the evaluation of what the children could remember without any further training, firstly after seven days of withdrawal and then after 30 days of withdrawal. During the post-training phase it was determined how many of the symbols were retained by the subjects. Two withdrawal periods were decided on to investigate possible tendencies that might develop if the withdrawal period was extended.

3.7. MATERIAL USED DURING DATA COLLECTION IN THE PRE- TRAINING, TRAINING AND POST-TRAINING PHASES

The data collection material used for the pre-training phase was similar to the material used during the training and post-training phases. An outline of the material used to assess the subjects during the three phases is provided below in Table XIV.

3.8. THE DEVELOPMENT OF TESTING/TRAINING MATERIAL

The training material was made up of 80 Uhsymbols and 80 CyberGlyphs representing the same concepts. The concepts were incorporated into four paragraphs, with each containing 20 of the selected concepts. Four training symbols (two Bliss and two Glyphs) were selected to demonstrate the testing procedure. Eight distracter symbols were included (two per paragraph). Table XV represents the outline of the training material used in the main study.

Table XIV: The data-collection material used during the pre-training, training and post-training phases

MATERIAL	OBJECTIVES
1. Evaluation forms were compiled for each subject to list selection criteria and to plot the results of the training and post-training phases	The plotting of the results obtained during the training phase and the post-training phase was done on the forms to facilitate statistical analysis
2. Four paragraphs were compiled containing the 80 concepts (represented by Bliss and Glyphs). Each paragraph was copied on an A3-sized paper with the relevant concepts (represented by the symbols) omitted. Each of the 50 subjects received a copy of the relevant paragraph and the individual concepts (words) that were left out were provided on separate cards. The subjects were instructed to insert the words omitted by attaching the individual words to the blank spaces with "Prestic". (See Appendix 6 for the paragraphs). The actual words were used at this stage and not the symbols, as the symbols had not been taught at the time of the pre-training phase	This part of the pre-evaluation phase tested the subjects' ability to read and understand the text. The subjects had to choose the correct word left out in the sentence. They had to paste the correct word in the relevant open space to complete the sentence. It also tested their understanding of the instructions to insert the omitted concepts. Since their knowledge of the concepts had already been tested in the pilot study, it was not a factor at this stage. If the subject chose an incorrect option, he/she was asked if he/she could see another word to use in the same sentence
3. For the training and post-training phases, the subjects were provided with individual symbols on 3-cm ² cards as well as a contact adhesive ("Prestic"). This included the 80 symbols + 2 distraction symbols	The cards were used to match the symbol with the relevant concept by pasting the symbol to the word
4. For the training and post-training phases, the same type of A3 paragraphs were given to the subjects as mentioned in 2 above. The relevant concepts were not omitted, but written in red ink.	During the training and the post-training phases, the subjects were expected to match the relevant symbol with the correct concept written in red. This was done by pasting the symbol onto the red word with "Prestic".
5. Pictures explaining the meaning of the selected symbols were created on A3-sized paper for Bliss and Glyphs. They were hand-drawn by the same person. (See Appendix F)	The pictures facilitated the explanation and training of the symbols. The pictures were drawn by the same person to ensure uniformity of the presentation of the symbols

3.8. THE DEVELOPMENT OF TESTING/TRAINING MATERIAL

The training material was made up of 80 Blissymbols and 80 CyberGlyphs representing the same concepts. The concepts were incorporated into four paragraphs, with each containing 20 of the selected concepts. Four training symbols (two Bliss and two Glyphs) were selected to demonstrate the testing procedure. Eight distracter symbols were included (two per paragraph). Table XV represents the outline of the training material used in the main study.

Table XV: Layout of the training material used in the main study

GROUP 1		GROUP 2
40 Blissymbols (Bliss A) 2 paragraphs with 20 symbols each (same paragraphs and concepts as used with Glyphs A) + 2 distracter symbols	Same concepts Containing: 11 nouns 11 verbs 10 adjectives 5 prepositions 3 pronouns	40 CyberGlyphs (Glyphs A) 2 paragraphs with 20 symbols each + 2 distracter symbols
40 CyberGlyphs (Glyphs B) 2 paragraphs with 20 symbols each (same paragraphs and concepts as used with Bliss B) + 2 distracter symbols	Same concepts Containing: 11 nouns 11 verbs 10 adjectives 5 prepositions 3 pronouns	40 Blissymbols (Bliss B) 2 paragraphs with 20 symbols each + 2 distracter symbols
TOTAL = 80 symbols		TOTAL = 80 symbols

3.8.1. Symbols

3.8.1.1. Symbol selection

The 80 symbols as well as four practice symbols were selected from Wood *et al.*, (1992) *Blissymbols Reference Guide* and 80 symbols and four practice symbols from Zavalani's (1995) *Jet Era Glyphs; a Pictographic Communication System*. As the study was concerned with the learnability of the symbols, symbols were selected according to the concepts they represent, and not according to the symbol characteristics. By selecting according to the concepts represented, it was ensured that the two systems could be compared on the manner in which these *concepts* were represented by the symbol system. The concepts selected were encountered in the daily vocabulary of the children and formed part of the functional use in the oral vocabularies of the subjects (Clark, 1981; Burroughs *et al.*, 1990). To ensure that the concepts were representative of the language used in the educational setting, six teachers (who translated the concepts into Northern Sotho) were asked to evaluate them to determine if these were concepts that they would use with the subjects in the classrooms. They all agreed that the concepts

were representative of the general educational concepts that they regularly used with the children.

3.8.1.2. Word categories

The symbols were selected so that five different word categories were represented, namely nouns, verbs, adjectives, pronouns and prepositions. These word categories were selected because similar categories exist in Northern Sotho and also to compare the subjects' performance to see whether certain categories were learned and retained better than others. Categories such as prepositions have more abstract symbol equivalents than nouns for instance and may be more difficult to acquire and retain. Each group was made up of the same number of concepts in each word category, namely, 11 nouns, 11 verbs, 3 pronouns, 10 adjectives and 5 prepositions in each group, which adds up to 40 different concepts for each group.

3.8.1.3. Level of difficulty of selected concepts

Because two different groups of concepts had to be chosen so that inter-group comparisons could be made, the concepts were selected in such a way that for both instances the concepts were on the same level of semantic difficulty. For example, if the concept "teacher" was selected for one group, the concept "student" was used for the other group. The concepts "winter" and "autumn" were used for one group and "summer" and "spring" for the other. The criteria therefore for having the concepts on the same level of difficulty was to select either the semantic equivalent of a concept or concepts of the same word category with a related meaning. This ensured that in both instances the level of difficulty of the concepts taught was kept as close as possible. This was done to reduce the risk of variables influencing the performance between the two groups. Teaching all the concepts to both groups, even though the symbols systems

representing them differed, also ensured this. The teachers translating the words into Northern Sotho were consulted in this regard and they agreed that the level of difficulty was comparable.

3.8.1.4. Development of new symbols

At the time of the study the CyberGlyphs dictionary was not fully developed. This resulted in some of the chosen concepts not having representations in Glyphs. New symbols had to be created for the concepts and are displayed in Table XVI. Where possible, this was done using Zavalani's rules (1995) that govern the creation of new Glyph symbols. The rules provided by Zavalani were incorporated and the logic depicted by the author to create the initial symbols was analysed to facilitate the generation of new symbols. The concepts could have been chosen using only existing CyberGlyphs, but in the quest for selecting concepts of the same level of difficulty, it was necessary to use symbols not yet developed in CyberGlyphs. Table XVI contains all the new symbols as well as the way in which they were created.

Table XVI: New symbols developed for the study

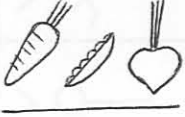

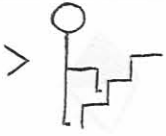
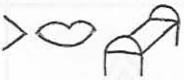
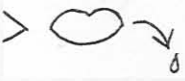

Word	Symbol	Ways in which symbol was created
Vegetables		The symbol used for fruit is a collection of pictographic symbols of three different types of fruit and underlined by a straight line. Because the concept of vegetables is very similar to that of fruit, two pictographic symbols of two kinds of vegetables were used (a carrot, peas and a turnip) also underlined by a straight line.
Plant		The symbol for flower is a pictographic drawing of a flower. The concepts of "plant" is very close to that of a flower, so a stem and leaves were combined to form the idea of a plant.
Climb		The symbol for a person performing an action was used, with the arms left out since only the prominent limbs are used in other symbols representing actions in Glyphs. The "person" was depicted climbing a set of stairs. The action indicator was placed in front of the symbol as was done with all the symbols representing verbs in Glyphs.
Yawn		A mouth was used as the first part of the symbol to indicate that the action involves the mouth. The symbol for "mouth" was taken from the Glyph for "sing". A bed was placed after the mouth to indicate that the action is related to bedtime. The action indicator was placed in front of the whole symbol.
Spit		A mouth was used to indicate an action involving the mouth. An arrow followed by a droplet from the mouth indicates the movement of something wet from the mouth. Again the action indicator was incorporated.
Throw		The symbol for a person was used with only the outstretched arms present (main limbs needed for this action). An arrow with a ball-shaped object at the end indicated something moving away from the arms. The action indicator was incorporated.

Table XVI: Continued

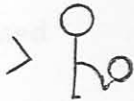




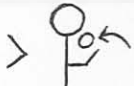










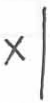


Kick		The same symbol for person was used, but with only the legs present. An object in the form of a ball was placed in front of one of the feet to indicate contact between the foot and the object. The action indicator was incorporated.
Stand		The symbol for person was used, standing erect. The arms were left out to indicate that the action involved the legs. The action indicator was incorporated.
Grow		The symbol for flower was used first and combined with an arrow pointing in an upward direction to indicate that the flower is moving up (as is the case in the Blissymbol indicating growing). The action indicator was incorporated.
Cough		The symbol for the mouth was used first to indicate the involvement of the mouth in the action. The two arrows indicate something moving from the mouth in a blowing motion. The exclamation mark indicates that it is a harsh or forceful action. The action indicator was incorporated.
Laugh		The symbol for mouth was used. Inside the mouth an opening was placed representing a laughing mouth. The action indicator was incorporated.
Catch		The same symbol for person was used as with "throw" with out-stretched arms. The direction of the arrow is <i>towards</i> the arms, indicating the receiving of an object into the arms. The action indicator was incorporated.
Run		A line drawing of a person in a running motion was used with arms and legs present to indicate the full movement of the body while running. The action indicator was incorporated.
Lie down		The same symbol used for "stand" was used here, but was turned on its side to indicate that the person is lying down. The action indicator was incorporated.
Green		The diamond that was originally used in Glyphs was used to indicate colour. Inside the diamond, three stems of grass were placed. The deduction that the colour of grass is green leads to the symbol representing "green".
Blue		On investigation of the colours already represented by Glyphs, it was found that some might be changed so that more possibilities for other colours might be included. Consequently, blue was changed from  to  . This provided a logical basis for the colour "brown" later on. The coloured top half of the diamond represented the top half of the earth (the sky), which is the colour blue.
White		Originally white was represented as a clear diamond but since no symbol has yet been created for the concept of colour itself, it was thought that the clear diamond would be a better representative of the concept "colour". The clear diamond within the bigger one indicated that the colour in question was blank. This new symbol is also the exact opposite of the Glyphs representing "black".
Brown		As mentioned above, brown was created as the opposite of "blue". The bottom half of the diamond was coloured, indicating the earth (soil), which is brown.

Table XVI: Continued

Yellow		A line drawing of the sun was placed in the diamond (representing colour) to indicate the colour of the sun (yellow).
Ugly		The existing symbol for "beautiful" was taken and the flower inside the circle was crossed out to indicate that it has the opposite meaning of "beautiful" namely "ugly".
In front of		A vertical line was used with an "x" in front of the line (on the left-hand side in Western orthography) to indicate position. The "x" was used because it is also used to indicate other concepts such as size (big; small) or position (top; bottom) in CyberGlyphs
Between		Two vertical lines were used with the "x" placed in between the two lines to indicate position.
Behind		A vertical line was used with the "x" behind the line (on the right-hand side of the line as in Western orthography). The position of the "x" indicates the concept "behind".

3.8.2. Paragraphs

Paragraphs were created to incorporate all the chosen concepts into a form that would contextualise the concepts for the subjects. It was also an attempt to make the training situation more interesting. This was important because motivation is a critical factor in the learning of symbols (Lane & Samples 1981). Four paragraphs were created, each containing 20 of the chosen concepts. As stated above, the teachers then translated the paragraphs from English to Northern Sotho. The criteria for the development of the paragraphs were that the selected nouns, verbs, adjectives, prepositions and pronouns were contained in the paragraphs. The distribution of the word categories is presented in Table XVII.

Table XVII: The distribution of word categories over the four paragraphs

Paragraph	Number of nouns	Number of verbs	Number of adjectives	Number of pronouns	Number of prepositions	Total number of concepts in each paragraph
1	8	3	6	0	3	20
2	3	8	4	3	2	20
3	8	3	5	2	2	20
4	3	8	5	1	3	20
Total	22	22	20	6	10	80

The paragraphs were relatively short, on the cognitive level of the subjects and formed short representations of familiar situations. According to Fey (1986) storytelling contexts provide linguistic and non-linguistic advantages that would not be found in other contexts. The English and Northern Sotho versions of the paragraphs are contained in Appendix E.

3.9. DESCRIPTION OF SYMBOLS IN TERMS OF ICONICITY

In order to understand the nature of the symbols included, it was important to rate the degree of iconicity of the symbols used in the study (Luftig & Bersani, 1985b). Iconicity was mentioned as one of the main factors influencing the learnability of Blissymbols in particular, but it could be hypothesised that it might have the same influence on other GSS like CyberGlyphs. Although not the main focus of the study, it was decided to compare the systems in terms of iconicity of concepts used.

To determine the degree of iconicity of the symbols used in the study, a rating scale had to be compiled according to which the different symbols could be rated (see Table XVIII). A seven-point scale similar to the rating scales used in the study of Luftig and Bersani (1985b) was developed. Five AAC specialists, familiar with GSS, were used as raters. They were asked to judge the degree of the relationship between the referent and the symbol where 1 represented no relationship between symbol and meaning, and 7

represented a very strong relationship between the referent and the symbol. The numbers between 1 and 7 were used to indicate some degree of relationship between the extremes of no relationship and a strong relationship.

Table XVIII: Iconicity rating scale

1	2	3	4	5	6	7
No relationship		←————→				Strong relationship

Figure 1: Iconicity rating for Bliss and Glyphs

3.9.1. Results of the iconicity rating

Since there were no major discrepancies between the ratings of the raters, the inter-rater agreement could be judged as reliable (see Table XIX).

Table XIX: Individual ratings by five iconicity raters

	Rater 1	Rater 2	Rater 3	Rater 4	Rater 5	Average
Bliss	2,73	3,33	3,86	3,41	3,32	3,33
Glyphs	3,60	3,70	3,82	3,80	4,10	3,8

The average of the individual ratings was calculated. A summary of the mean percentages of the general iconicity rating of the two symbol systems according to the five raters is presented in Figure 1.

N = nouns V = verbs A = adjectives PN = pronouns PP = prepositions

Figure 2: Iconicity ratings of different word categories

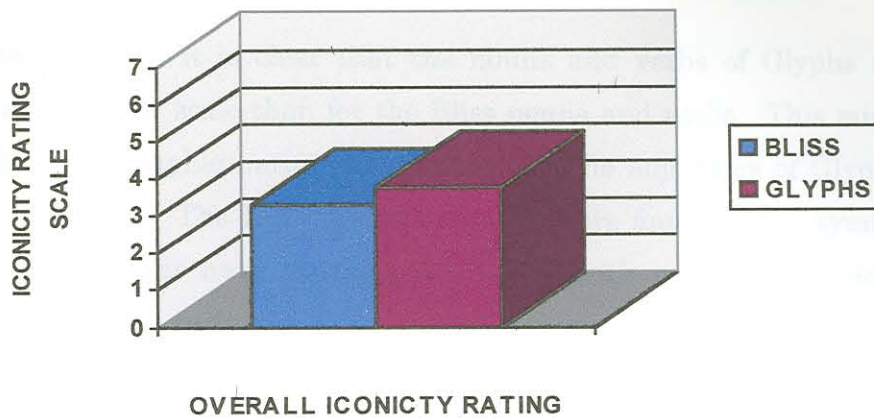
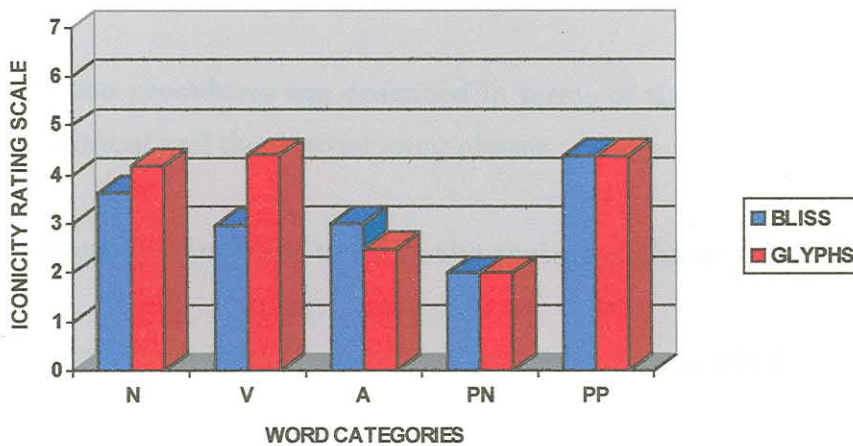


Figure 1: Iconicity rating for Bliss and Glyphs


From the iconicity rating it is clear that the ratings of both symbol systems were very close, namely 3.33 (out of a possible 7) for Bliss and 3.80 (out of a possible 7) for Glyphs. However, when one compares this with the overall superior ratings of Glyphs by the raters, it is necessary to analyse the iconicity results in more detail.

The iconicity ratings were divided into the different word categories to investigate any significant differences visible on that level. The results are presented in Figure 2.



N = nouns V = verbs A = adjectives PN = pronouns PP = prepositions

Figure 2: Iconicity ratings of different word categories

From the data it is clear that the nouns and verbs of Glyphs scored higher on the iconicity rating scale than for the Bliss nouns and verbs. This might be because of the higher pictographic nature of the Glyphs. The adjectives of Glyphs scored lower than those of Bliss. The Bliss description indicators found in the symbols representing the adjectives might have provided the raters with more information and resulted in a higher iconicity rating for these symbols. For example, the symbol for “ugly”  in Bliss has the description indicator to state that the symbol is describing *what something looks like*. The Glyphs adjectives do not have a description indicator. Pronouns and prepositions were rated equal. The level of abstraction for these concepts is very high. There is no pictographic way of depicting them and therefore results of the two symbol systems were similar.

From the results obtained with the iconicity rating scale it seems that the overall iconicity rating of Blissymbols and CyberGlyphs were relatively similar. However, when the different word categories were analysed separately, Glyphs were rated as more iconic for nouns and verbs only. The results of the iconicity rating for individual words are presented in Appendix G.

3.10. DATA-COLLECTION PROCEDURE

Data-collection procedures are described in terms of the training and evaluations made after the training and the post-training phases.

3.10.1. General principles used in the training phase

During the training phase, the following principles were applied:

- Training for Groups 1 and 2 commenced on the same day.
- Training was performed in a quiet room, which could accommodate the whole group. This was done at the school that the children attended.

- Training commenced at 08h00 for the first group of 20 symbols. This was followed by a break of 15 minutes before commencing the second session for the training of the second group of 20 symbols.
- Training order and starting time were alternated each day for the two groups in order to avoid one group having the advantage of being trained and tested earlier in the day than the other.
- The subjects were seated at individual desks and facing the blackboard, as in a teaching situation.
- The subjects were seated in such a way that they did not have a view of each other's work.
- Training was performed by the same fieldworker for both groups and took place in Northern Sotho. The researcher was present at all times.
- Verbal rewards were given after each training and testing session by praising the children for their co-operation. After the completion of the study, the children were given ice cream as a concrete reward and thanked for their participation.
- Two practice items were used before the first actual testing period so that the children could be familiarised with the testing procedure.
- During the explanation of the symbols, each symbol was taught using a six-step procedure (see 3.10.2 with an example of the procedure in Appendix H).

3.10.2. Training procedure

The training and testing procedures were the same for both groups, one learning Bliss and the other learning Glyphs, with only the symbols differing. Preparing the translated instructions and explanations for the fieldworker to read from a script ensured this. To maintain a high level of motivation of the subjects, the teacher was allowed to make her own interjections (e.g. "very good" or "you are all very clever"). The presentation of the pictures explaining the symbols also added to the children's amusement (Appendix F).

The training occurred over a period of four days for both groups. Eighty symbols in total were taught to the subjects of each group (40 Blissymbols and 40 Glyphs respectively for Group 1 and 40 Glyphs and 40 Bliss respectively for Group 2, as outlined in Table XI).


Forty Blissymbols (incorporated into two paragraphs) were taught to Group 1 on the first day and 40 Glyphs (incorporated into two paragraphs) were taught to Group 2. The training was repeated on day 2 for both groups where Group 1 was taught 40 Glyphs and Group 2 was taught 40 Blissymbols.

Twenty symbols were taught at a time, as 20 symbols were incorporated into each paragraph. The symbols were presented individually, together with a relevant picture and an analytical description of the symbol. Each symbol was explained according to its features. Care was taken to explain the symbols exactly according to their different features by reading from the translated script so that no additional explanations or

remarks were given. This was done to prevent one symbol from being explained in either more, or less detail than the others.

During training a total of six basic presentation steps were followed for each symbol. A symbol was explained in a similar way as in Shepherd and Haaf, (1995) where the different symbol elements were explained individually. Schlosser and Lloyd (1993) also found that more successful learning of Blissymbols takes place when each element of the compound is explained. The procedure took on the following format:

- Step 1: Naming the symbols
- Step 2: Explaining the symbol individually according to the relevant picture
- Step 3: After all the symbols had been explained individually, the explanation was then repeated for all the symbols
- Step 4: The subjects named all 20 symbols

- Step 4: The subjects named all 20 symbols
- Step 5: The 20 symbols were then incorporated into a paragraph. The symbols replaced the particular concept in the paragraph, as would be the case with Rebus e.g. / Go a  lehono . (It is very *hot* today). These were presented on the blackboard. The paragraph was read to the group by the fieldworker
- Step 6: The students read the paragraph as a group.

The actual training for a group of symbols consisted of an explanation of the testing procedure and what was expected of the subjects; the explanation of the action and adjective indicators; and the actual training for the symbols and the testing instructions. Two days of revision followed where the training phase was repeated to ensure that the subjects knew the symbols well. A withdrawal period of seven days followed, after which the subjects were tested on all the symbols they had learned the previous week. No training was given after the withdrawal period. This was repeated again after 30 days of withdrawal. A schematic representation of the training and post-training phases and arrangement of the paragraphs is provided in Table XX.

Table XIX: Schematic presentation of the training and post-training phases

DAY 1	DAY 2	DAY 3	DAY 4	7 DAYS WITHDRAWAL	30 DAYS WITHDRAWAL
GROUP 1 Training of 20 new Blissymbols (paragraph 1) + Testing of symbols taught (par. 1)	GROUP 2 Training of 20 new Blissymbols (par. 3) + Testing of symbols taught (par. 3)	GROUP 1 Revision of Blissymbols (par. 1) + Testing of symbols (par. 1)	GROUP 2 Revision of Blissymbols (par. 3) + Testing of symbols (par. 3)	GROUP 1 No further training Testing of 40 Blissymbols (par. 1 & 2)	GROUP 2 No further training Testing of 40 Glyphs (par. 3 & 4)
<i>15 minute break</i>	<i>15 minute break</i>	<i>15 minute break</i>	<i>15 minute break</i>	<i>15 minute break</i>	<i>15 minute break</i>
Training of 20 new Blissymbols (par. 2) + Testing of symbols taught (par. 2)	Training of 20 new Blissymbols (par. 4) + Testing of symbols taught (par. 4)	Revision of Blissymbols (par. 2) + Testing of symbols (par. 2)	Revision of Blissymbols (par. 4) + Testing of symbols (par. 4)	No further training Testing of 40 Glyphs (par. 3 & 4)	No further training Testing of 40 Blissymbols (par. 3 & 4)
GROUP 2 Training of 20 new Glyphs (par. 1) + Testing of symbols taught (par. 1)	GROUP 1 Training of 20 new Glyphs (par. 3) + Testing of symbols taught (par. 3)	GROUP 2 Revision of Glyphs (par. 1) + Testing of symbols (par. 1)	GROUP 1 Revision of Glyphs (par. 3) + Testing of symbols (par. 3)	GROUP 2 No further training Testing of 40 Glyphs (par. 1 & 2)	GROUP 1 No further training Testing of 40 Blissymbols (par. 1 & 2)
<i>15 minute break</i>	<i>15 minute break</i>	<i>15 minute break</i>	<i>15 minute break</i>	<i>15 minute break</i>	<i>15 minute break</i>
Training of 20 new Glyphs (par. 2) + Testing of symbols taught (par. 2)	Training of 20 new Glyphs (par. 4) + Testing of symbols taught (par. 3 & 4)	Revision of Glyphs (par. 2) + Testing of symbols (par. 2)	Revision of Glyphs (par. 4) + Testing of symbols (par. 4)	No further training Testing of 40 Blissymbols (par. 3 & 4)	No further training Testing of 40 Glyphs (par. 3 & 4)

3.10.3. Testing: Post-training and withdrawal procedures

- The subjects were instructed to match the individual symbols with the relevant concepts. This implies that they had to recognise the correct symbol in order to match it to the referent. No recall from memory was needed to reproduce the symbols.
- A short practice session of two symbols was given before testing, after the first training session. They were taught two symbols namely “shout” and “dog” and had to match the two symbols (presented on a 3-cm card) with the relative concepts in a sentence where the words “shout” and “dog” were written in red. The correct symbols had to be pasted on the matching words with “Prestic”. In other words, the subjects matched the symbol with the appropriate concept.
- This procedure was repeated with the actual symbols. Two distracter symbols were incorporated in the group of symbols presented to the subjects, as suggested by Light and Lindsay (1991).
- Each subject was allocated an identification number, which appeared on every paper containing a test paragraph. The subjects’ responses were calculated in terms of a percentage value per paragraph for the number of concepts correctly replaced by a symbol.
- The incorrect responses were annotated for each subject according to the word category it represented (e.g. verbs, nouns etc.).
- The responses for each individual were written on an evaluation form.

3.11. DATA ANALYSIS

3.11.1. Procedures for testing

During each training session an external observer (researcher) was present who used a video recorder to ensure the consistency of presentation of each symbol. The presentations were also followed on the script that had been prepared for the fieldworker. The video-recorded data were analysed by one of the teachers involved in the translation of the training material. She was provided with a script of the

presentations. She was asked to note any additional comments that were made by the trainer and to indicate any omissions, additions or changes that might have occurred. The results of the analysis showed that the only additional information presented during the training and revision was interjections made by the trainer to indicate correct or incorrect answers, e.g. “o hlalefela kudu” (you are very clever) or additions “go lokile” (yes, that is correct). No omissions of the explanatory sentences occurred during the training session. Some additions were made during the training of paragraph 1 and during the revision training of paragraph 4 for Group 1 where the trainer repeated the name of the symbol after making an interjection: “Yes, very good. This means *flower*” and “Good. This is to *kick* something” (during Step 2 of 3.10.2). This occurred once during the training for paragraph 4 for Group 2 where Step 1 (3.10.2) was repeated for the concept “*black*”. The results are summarised in Table XX.

Table XX: Analysis of the presentation of the testing material

	Analysis of the training session					
	Group 1			Group 2		
	Interjections	Omissions	Additions / Changes	Interjections	Omissions	Additions / Changes
Par. 1	12	0	1	13	0	0
Par. 2	10	0	0	10	0	0
Par. 3	12	0	0	11	0	0
Par. 4	9	0	0	9	0	1
Rev. 1	11	0	0	10	0	0
Rev. 2	10	0	0	12	0	0
Rev. 3	12	0	0	9	0	0
Rev. 4	14	0	1	13	0	0
TOTAL	90	0	2	87	0	1

Directly after the first training session the subjects were tested on the first 20 symbols of the first paragraph in the group. Responses required recognising the symbol and matching it with the relevant concept. It was then scored as either correct or incorrect.

3.11.2. Error analysis

The error analysis was done by calculating the percentage of the number of symbols correctly identified for each paragraph. After determining individual scores, a global score was calculated for each paragraph, as well as for each stage of training (first

training session, revision, withdrawal 1 and withdrawal 2). After obtaining a mean percentage for each session and for each symbol system, the data were analysed according to the different word categories. A mean percentage for each symbol from each word category was calculated by determining how many subjects identified the relevant symbol *incorrectly*. In doing so, it was determined whether some of the word categories used in this study proved to be more difficult to learn or retain than others.

3.12. DATA PROCESSING AND STATISTICAL ANALYSIS

Descriptive statistics were employed whereby conclusions were drawn from percentages and raw data. Visual representation of data is provided. Statistical procedures were also employed and the *t*-test was used to determine the statistical differences in performance between the two symbol systems.

The objectives of using statistical procedures were the following:

- To determine whether there were any significant differences between performance on Bliss and Glyphs in terms of ease of learning and retention
- To determine which word category represented by the symbols (nouns, verbs etc.) was less successfully acquired and retained.

3.12.1. The *t*-test

The standard error and *t*-values are presented in Table XXII (4.3.1) to indicate the standard deviation of the sampling distribution and the significant differences between the two symbol systems. To test for statistically significant differences between various means, the *t*-test for small, uncorrelated samples was used as in the following equation:

$$t = \frac{M_1 - M_2}{\sqrt{\left\{ \frac{\left(\frac{N_1 \sum x_1^2 - (\sum x_1)^2}{N_1} \right) + \left(\frac{N_2 \sum x_2^2 - (\sum x_2)^2}{N_2} \right)}{N_1 + N_2 - 2} \right\} \left\{ \frac{N_1 + N_2}{N_1 N_2} \right\}}}$$

where M_1 and M_2 refer to the means of the two respective groups, N_1 and N_2 to the

number of observations in the two respective groups, σ_{X1} . The obtained t -value was checked in Fisher's table for t -values against the number of degrees of freedom (df) where $df = N1 + N2 - 2$.

To check for significance of difference, a hypothesis is stated in the null form, i.e. that observed differences between the two means compared are obtained through chance variations in the process of sampling and are therefore not significant. The obtained t -value will indicate the degree of confidence that can be placed on acceptance of the null-hypothesis, i.e. that no significant difference exists.

When the obtained t -value, checked against the appropriate degrees of freedom, results in a probability figure of $p = 0,05$, it suggests that the observed difference between the means will only occur five times in every 100 occasions, purely on the basis of chance fluctuations in the process of sampling. The null-hypothesis will then be rejected and the results are typically referred to as being significant at the 0,05 level. Stated differently, one can say that the null-hypothesis can only be accepted with a 5% level of confidence, or significant differences exist with a 95% level of confidence. Such a level of confidence is traditionally indicated with an asterisk (*).

The t -tests could give an indication of the significance of difference between the acquisition and retention of the two symbol systems. In addition, it could also give an indication whether the results obtained for the different word categories were significant. The results of this analysis will be discussed in Chapter 4.

3.13. SUMMARY

In this chapter the methodology was described. It included the aim of the study and the objectives to be reached. Furthermore, the selection criteria, descriptive information, material and equipment used during the pilot and main study were included. The chapter also included data on the iconicity rating of the symbols used in the study. Finally, data collection procedures and analysis were discussed.