CHAPTER 4
RESULTS AND DISCUSSION

4.1 Introduction

In this chapter the results of the study are presented and discussed with reference to the aim of the study, which was to determine the influence of using graphic representations of signs in teaching signs to hearing mothers. The two sub-aims - the first to compare the acquisition of signs by teaching signs with and without sign illustrations, and the second to compare these strategies of sign teaching with regard to the assistance provided by the trainer during sign learning - form the main comparisons in the evaluation of the impact of sign illustrations. These aspects were described in the previous chapter that presented the methodology used in the study.

The research design, viz. the AATD (described in Table 3.1) had to be closely adhered to in order to determine the influence of the sign illustrations on sign learning. Four participants attended four half-hour sign training sessions over four consecutive days, during which they all learned the same four pre-selected theme-based sign sets, which were alternated together with the two teaching strategies. Two themes were taught using the strategy of graphics, in which sign illustrations in a theme-based graphic display together with signing was used, and two themes were taught with the strategy of signing-only, in which only lists of the sign glosses were used. The training strategies were described in Table 3.7. A total of 96 signs, 24 in each theme, were taught. Of these, 15 signs per theme, i.e. 60 signs per strategy served as probes for the comparison of strategies with regard to the acquisition of signs and trainer assistance required during sign learning. (The signs sets are presented in Table 3.8).

As the design was specifically chosen to allow for comparison of the sign teaching strategies, the accuracy of the scoring of signs and the assistance provided as measured by the probe signs was critical. The scoring was thus subjected to reliability measures to ensure accuracy and thus confidence in the data. (A description of the procedures used is presented in Section 3.6.4.3). These results will be presented first.

4.2 Reliability of data

Reliability measures involved both the evaluation of the treatment integrity of the training to determine the extent to which procedures were conducted as stipulated in the training schedule, and the inter-rating of sign acquisition scores and assistance scores.

4.2.1 Treatment integrity of the training

Two aspects were considered with regard to treatment integrity. Firstly the consistency of the training was assessed to determine whether all components in a session were conducted, and secondly the adherence to the training strategies in terms of the teaching criteria was conducted, as described in Section 3.5.2.3 of the methodology.

As described in Section 3.6.4.3 (and shown in Appendix 28), 37, 5% (six randomly selected sessions of 16 video sessions) were observed for treatment integrity. The result was that a total of 52 items were checked (Appendix 32). In addition, these same sessions, 37.5% of the total number of sessions were also observed for implementation of the teaching strategies (Appendix 33) with regard to instructions (30 items were checked), demonstrations by the trainer (360 items were checked), the participants' imitations (360 items were checked) and self practice (900 items were checked) to determine the extent to which teaching criteria were observed. The results of the ratings for treatment integrity are presented in Table 4.1. Note the scores were added and averaged where necessary for presentation.

Table 4.1 Results for treatment integrity ratings

Aspect	Inter-rater agreement
1. Treatment integrity of training sessions	96% (desirable consistency)
2. Treatment integrity of training procedures - Instructions - Sign demonstrations - Sign imitations - Sign practice	100% (desirable consistency) 99% (desirable consistency) 98% (desirable consistency) 99% (desirable consistency)

These results, with scores ranging from 96 - 100%, indicate high inter-rater agreement, implying that the training was essentially administered as planned and that the results can

therefore be interpreted with confidence with regard to the training being consistent across the four participants and across the different sessions.

4.2.2 Inter-rater reliability of scoring

4.2.2.1 Inter-rater reliability of sign acquisition scores

As described in Appendix 28, all probe signs, i.e.100% of the data (15 per set, 60 across the four sets), were inter-rated for all probe measures, pre-and post-training (P0-P3) by Inter-rater 2. Thus 960 signs were observed for sign-production (expression) and 960 for sign-understanding (reception). (The results of the inter-rating procedure across themes and participants are presented in Appendix 34). A summary in terms of expressive and receptive scores is presented in Table 4.2.

Table 4.2 Inter-rater reliability ratings of sign acquisition scores

Aspect	Inter-rater agreement
Inter-rating of sign acquisition scores	Sign production: 95% (desirable consistency)
	Sign understanding: 98% (desirable consistency)

The above ratings exceed 90%, which reflects a desirable consistency in the inter-rater scoring of the probe signs (Richards et al., 1997), and thus the sign acquisition data is considered reliable.

4.2.2.2 Inter-rater reliability of trainer assistance scores

These measures looked at the procedural aspects of the training related to Aim Two - to determine the amount and nature of assistance required during self practice. Inter-rater 1 observed six sessions - 37.5% of the data - evaluating the assistance provided for the 15 probe signs per session during self practice of signs trained to criterion (Appendix 28). As there were three phases of practice for each sign, 270 signs were observed and the kind of assistance required noted. An inter-rater agreement score of 88% was obtained. (The results are presented in detail in Appendix 35). Whilst the score of 88% for trainer assistance is lower than the desirable consistency (90%), it does fall within the "adequate" margins of 70-89% (Richards et al., 1997).

In summary, the inter-ratings on the various aspects ranged from adequate to desirable and indicate that the sign teaching strategies were implemented as planned, and the participant responses are reflected accurately in the calculations of sign acquisition and assistance received during training.

4.3 Comparison of the effectiveness of the two sign teaching strategies

The comparison of the teaching strategies which related to the two sub-aims of the study essentially involved comparing the number of signs acquired with each of the teaching strategies, as well as the number of signs with which assistance was required and the nature of that assistance. Sign acquisition was approached in terms of three post-training measures which were adjusted to account for initial baseline scores. The three post-training measures were recall (immediately following training on the same day), retention (one day post-training) and withdrawal (one week post-training) as described in Section 3.6.4 of the methodology

4.3.1 Set equivalence

An additional consideration prior to the above comparisons was the influence of the sign sets on sign acquisition. This was important as the AATD called for the use of equivalent sets in the comparisons - four in this case. Thus the ANOVA was used to verify this. The comparisons considered the influence of sets on the scores related to the three post-training probes. The results of the statistical analyses indicated that there were no significant differences on the acquisition probes for both sign production and sign understanding that could be attributed to the sign sets used in the training, as the p-values were greater than 0.05 as reflected in Table 4.3.

Table 4.3 Influence of theme probe sets on sign acquisition

Sign acquisition probes compared across themes	Sign Production (p-value)	Sign Understanding (p-value)
Immediate recall	0.967	0.634
One day retention	0.895	0.712
One week withdrawal	0.753	0.997

* All statistically significant values on the 5% level of confidence are indicated with an asterisk

It is therefore evident that the probes for the four sign sets were balanced for equivalence as required for the AATD, and therefore allowed for reliable comparisons. This lack of effect of set on the training conditions confirms the procedures used to develop and test equivalence of probe-sign sets, as described in the pre-experimental phase of the study in Section 3.5.2.1.

4.3.2 Sign acquisition

Sign acquisition was examined in terms of both production and understanding of individual probe signs. The results on these aspects for both sign teaching strategies will be presented in this section.

4.3.2.1 Sign production

It must be noted at this stage that the participants were not sign-naïve and although they were matched as closely as possible, there were slight differences in their baseline skills which may be seen to have a bearing on the results, despite their serving as their own controls in the study. The participant knowledge of probe signs in the different conditions pre-training is presented in Table 4.4. (Detailed individual results across the sign sets are presented in Appendix 39).

Table 4.4 Signs produced by individual participants pre-training

	Graphics (N=30)		Signing-only (N=30)	
Participant	Frequency	Percentage	Frequency	Percentage
SG	3	10%	4	13%
D	1	3%	3	10%
SA	6	20%	8	27%
R	4	13%	3	10%
Total	14	11.6%	18	15%

Pre-training SA knew the most probe signs, i.e. six (20%) of the 30 signs in the graphics strategy, and eight (27%) of the 30 signs in the signing-only strategy. In fact three participants knew more signs in the signing only strategy as reflected in Table 4, resulting in four extra signs known in this strategy. This overall higher pre-training score in the signing-only strategy is evident when comparing the mean sign production acquisition scores comparing the conditions as shown in Table 4.5.

Table 4.5 Sign production: comparison of means across teaching strategies

	Strategy			
Probes	**Graphics (N=8)**		**Signing-only (N=8)**	
	$\overline{X}$	STD	$\overline{X}$	STD
Pre-training Probe (P0)	1.62	1.30	2.25	1.16
Post training probe, day one (P1)	11.87	2.23	11.87	2.16
Post training probe, day two (P2)	11.12	2.23	11.12	2.43
Post training probe, one week (P3)	8.87	2.47	8.37	1.76

The two post-training probes (P1& P2) in the graphics strategy reflect a catching up with, and then overtaking of this superiority of the signing-only strategy in the withdrawal probe (P3) a week later. This difference in gains measured on post-training measures, taking into account pre-training scores, was tested using the ANOVA. The results however, reflected no significant differences on all three post training measures (recall, retention and withdrawal) although greater gains were made in the graphics condition as reflected in Table 4.6.

Table 4.6 Sign production: comparisons of the two teaching strategies

Gains in sign acquisition	Strategy				p-value
	Graphics (N=8)		Signing-only (N=8)		
	$\overline{X}$	STD	$\overline{X}$	STD	
Immediate recall	10.25	2.12	9.62	1.76	0.55
One day retention	9.50	2.32	9.00	2.39	0.70
One week withdrawal	7.25	2.54	6.12	1.55	0.34

* All statistically significant values on the 5% level of confidence are indicated with an asterisk

Although the differences are not significant, the graphics strategy was stronger on all three post-training probes, with the biggest difference on the final withdrawal probe. It would appear then that the graphics strategy is somewhat stronger in promoting sign production. It is possible that with a larger sample a more significant effect could have emerged. These higher scores for the graphics condition could explain the perception of the benefit of the graphics strategy over the signing-only strategy reported by the participants. All participants commented on the benefit of the sign illustrations. Three participants actually felt it was more useful than the word lists. The following comments were made by the participants - R: "*The pictures were more helpful - show you the sign*"; SG: "*From where I started, I needed illustrations - show me how to grasp it. I am not really that good at knowing how the sign is positioned as such;* D: "*Only words, was a little hard*"; R: "*Seeing the pictures helped me a lot. Because even if don't know anything about sign language by seeing the picture - gives you as idea about how to go about it... I found it a very big help looking at the pictures*" (Appendix 36).

The reasons for this lack of significant effect with regard to sign production, despite the reported benefit, and the initial assumption that this multi-modal input would enhance learning of signs may be explained as follows:

Firstly, it could be speculated that the low demand of the evaluation task was a factor. Only 24 signs were taught on a day, with just 15 of these being probed, as the design constraints had reduced the number of signs that could serve as probes (as described in Table 3.8). Thus, a total of 60 signs learned over a period of four days, were used to compare the two teaching

strategies. This is a relatively small number of signs, given the fact that the participants were not sign-naïve. This could have been compounded by the fact that the probes themselves, especially in the receptive mode, served as additional input and as an alert of their importance in the post-training measures. An attempt to control for this was made by changing the order of the signs on the probe lists for expression and reception, and by probing for sign production first.

However, it must be noted that the signs themselves were not "easy" as the majority of signs were low translucency signs (73%) with 67% being classified as having difficult handshapes (as described in Table 3.8). This is evidenced by the fact that only one participant, SA, received a 100% score, and this on only one occasion (P1, Set One), and that having had a pre-training score of four (as reflected in Appendix 39). In addition, two sets of signs were probed on a day making the task somewhat challenging.

Another factor was the training procedure itself which, although developed out of a series of pilot studies that indicated a need for many practice opportunities, could have contributed to the guarantee of success with both strategies. The total of 10 available practice opportunities as stipulated by the teaching criteria, with opportunities for assistance throughout, could have masked difficulties which could have arisen with a particular strategy.

Also, the theoretical underpinning of the study, namely the issue of multimodality in the learning task, could have had an influence on the lack of a significant effect of the graphics condition. First, the bimodal input with regard to signing and speaking during sign learning in both conditions could have assisted with learning of signs, by recoding of the speech message into graphic or sign modality (Smith, 2006). Fourie (1997) noted that the participant in his single subject study of comparative media, used speech to mediate learning of sign vocabulary. Secondly, the use of the graphics together with the signing could be seen as redundant (Alant, Bornman & Lloyd, 2006; Loncke, Campbell, England & Haley, 2006), when initially learning to sign over a short period of time as the participants could be more focused on the demonstration of the sign to master production in three-dimensional space rather than the graphic representation which could be perceived as providing additional and non-essential information. The value of the graphic representation might thus be more apparent over prolonged training.

Finally, the training procedure required minimal focus on the graphic display by providing additional input through both signing and speech. The participants only pointed to the display during the training as a point of focus. Arrows depicting movement were not explained, and participants' attention was not overtly drawn to sign parameters reflected in the sign illustration. The participants were expected to link the illustrations to the signs, without any direction on how to do so. The reason for this was the consideration of experimental control to ensure that additional information on sign formation was not given in the graphics condition and thus possibly lead to contamination of the design. It is possible that greater focus on the sign parameters reflected in the sign illustrations could have assisted in the recall of the signs. Additionally, the elicitation of the signs using the sign illustrations as cues could also have more clearly reflected the impact of the graphic representation on the recall of the signs. However, to more fully address the acquisition of signs, the ability to understand the signs was also probed.

4.3.2.2 Understanding of signs

Once again, prior knowledge of signs had to be considered to establish gains made with implementation of the two sign teaching strategies. A relatively high number of probe signs were understood by participants pre-training as reflected in Table 4.7. (Individual results across the themes and teaching strategies are presented in Appendix 40).

Table 4.7 Signs understood by individual participants pre-training

Participant	Graphics (N=30)		Signing-only (N=30)	
	Frequency	Percentage	Frequency	Percentage
SG	9	30%	8	26%
D	2	6%	6	20%
SA	7	23%	5	16%
R	5	16%	5	16%
Total	23	19%5	24	20%

The initial scores comparing the strategies are similar, with just a percentage higher in the signing-only condition. Two of the participants knew more signs with the graphics strategy, while the other two knew more signs with the signing-only strategy. It therefore appears that scores were spread almost equally over the two strategies. This close matching of conditions pre-training translated into closely matched gains post-training, as reflected in Table 4.8.

Table 4.8 Understanding of signs: comparison of means across teaching strategies

	Strategy			
Probes	**Graphics (N-8)**		**Signing-only (N-8)**	
	$\overline{X}$	STD	$\overline{X}$	STD
Pre-training Probe (P0)	2.875	1.726	3.000	1.690
Post training probe, day one (P1)	13.000	1.690	13.125	1.807
Post training probe, day two (P2)	12.750	1.581	13.000	2.203
Post training probe, one week (P3)	11.375	2.326	11.500	2.828

The ANOVA showed no significant differences ($p > 0.05$) on the understanding of signs when the two strategies were compared across the four probes as reflected in Table 4.9.

Table 4.9 Understanding of signs: comparisons of the teaching strategies

Gains in understanding of signs	Strategy				p-value
	Graphics (N=8)		**Signing-only (N=8)**		
	$\overline{X}$	STD	$\overline{X}$	STD	
Immediate recall	10.125	2.531	10.125	2.695	1.000
One day retention	9.875	2.167	10.000	2.976	0.929
One week withdrawal	8.500	2.828	8.500	3.338	1.000

* All statistically significant values on the 5% level of confidence are indicated with an asterisk

This finding could be explained by the fact that the training procedure was identical with regard to the input of signing via demonstrations for both strategies, with a high number of observation opportunities as stipulated in the teaching criteria. Once again, the role of the sign illustrations was minimal in terms of input with participants required to point to, while assisted by the gloss, rather than comprehend the graphic representation. The evaluation method matched the input of manual signing as the focus was almost entirely on the real time observation of the sign. Thus, it could be argued that there was less multimodal input influencing outcomes, although the graphic representations were available.

In addition, the testing procedure itself, with the first three probes presented over two consecutive days, could have served as additional learning opportunities. As a limited number of signs were probed in each session, participants could once more, as discussed in the production aspect earlier, have associated sign demonstrations with the probes linked to them, using these as additional input practice.

In summary, it was evident that there were no significant differences between the strategies for both the production and understanding of signs. However, the production of signs did show a tendency for graphics to have been advantageous. Thus a comparison of the conditions with regard to the difference between production and understanding of signs was further explored.

4.3.2.3 Difference between production and understanding of signs

When considering individual scores, it is evident that pre-training more signs (20%) were understood than produced (13%), as reflected in Table 4.5 and Table 4.8 respectively. These higher receptive scores are also evident in the mean scores for all other post-training measures across the conditions, as reflected in Table 4.10.

Table 4.10 Comparison of sign production and sign understanding across strategies

Probe	Graphics (N = 8)		Signing-only (N = 8)	
	Expression	Reception	Expression	Reception
	$\overline{X}$	$\overline{X}$	$\overline{X}$	$\overline{X}$
Pre-training Probe (P0)	1.62	2.875	2.25	3.000
Post training probe, day one (P1)	11.87	13.000	11.87	13.125
Post training probe, day two (P2)	11.12	12.750	11.12	13.000
Post training probe, one week (P3)	8.87	11.375	8.37	11.500

These differences, when explored on the Wilcoxon test, were significant for both strategies, as shown on in Table 4.11.

Table 4.11 Comparison of strategies with regard to differences between sign production and sign understanding

Probe	Difference between sign production and sign understanding					
	Graphics			**Signing-only (N=8)**		
	$\overline{X}$	STD	p-value	$\overline{X}$	STD	p-value
Pre-training Probe (P0)	1.250	1.38	0.06	0.750	1.90	0.37
Post training probe, day one (P1)	1.250	1.24	0.07	1.250	1.03	**0.03***
Post training probe, day two (P2)	1.625	1.92	0.07	1.750	0.46	**0.00***
Post training probe, one week (P3)	2.500	1.30	**0.00***	3.125	1.88	**0.01***

* All statistically significant values on the 5% level of confidence are indicated with an asterisk

With the graphics strategy, the difference between sign understanding and sign production was only significant for the final probe a week later (p-value was < 0.01). With the signing-only strategy, all post-training measures showed that sign understanding was significantly better than sign production. However, the final probe was significant at the 0.05 level compared to the graphics strategy, which was significant at the 0.01 level. Thus at withdrawal, it appears the gap was more significant with graphics. It may be that sign understanding was retained better over time with sign illustrations. However with the signing-only strategy there were significant differences between reception and expression, with the gaps indicating a persistence of better sign understanding than expression.

Possible explanations could be that the production of signs, which is demanding in terms of motor requirements and judged on all sign parameters on assessing for accuracy of signs, could be viewed as more stringent compared to the task of identifying the sign. It must also be noted that signs were selected for both cheremic dissimilarity and semantic similarity to promote ease of learning, and to prevent confusion in learning signs. These factors then could have had a positive influence on the understanding signs. However, the fact that the

understanding of signs was superior to producing signs (Table 4.10) also seems to indicate that language learning had occurred as comprehension is considered better than expression in language acquisition in second language learning (Glass, 1997). This further supports the impression of the participants that they had benefited from the training. Pre-training, participants unanimously described their signing as inadequate with descriptions such as *"pathetic", "very bad"* and *"basic".* Post-training all participants felt their signing had *"definitely"* improved (Appendix 37).

In summary, the hypotheses for the superiority of the graphics over the signing-only strategy in learning to produce and understand signs were not proven. However, the graphics strategy showed a tendency towards supporting sign production, as reflected in Table 4.7, indicating its possible benefit in teaching signs. Further, the graphics strategy was equally strong in acquiring an understanding of the probe signs, which also appeared to be better retained than with the signing-only strategy. This tendency when seen in an AATD in a clinical setting could indicate the continuation of the strategy in further intervention.

As descriptive participant feedback (Appendix 36) indicated that the graphics strategy was beneficial, despite this not being clearly evident in the acquisition of signs, the nature of the training was explored with regard to the benefit of the graphics condition. Schlosser (2003) notes that while strategies being compared in Alternating Treatments Designs may not show superiority of one over the other on acquisition measures, other effects relating to efficiency of strategies may emerge.

4.3.3 Trainer assistance during practice

The participants needed to be taught to produce signs despite the fact that they had all started with knowing at least a few signs (Section 4.4.1). In other words, they were not sign-naïve. This was done in the context of the teaching criteria. The teaching criteria had involved teaching accurate production following demonstrations and imitations of the sign as described in Section 3.5.1.4. There were 10 practice opportunities during which time the participants used the training material to practice the signs. This was done for both probe and non-probe signs, individually and in two-sign combinations using a KWS approach. Two thirds (four) of the signs were without voice and six were voiced as described in Section 3.5.1.4 of the methodology. Each probe sign was observed at three self-practice

phases. In each of these phases assistance was provided as the need arose. The participants were assisted either at their request or by the trainer in the case of an incorrect production. All assistance was categorized as either another demonstration of the sign or a corrected production of an attempted sign. The inter-rater agreement of the scoring was presented in Table 4.3. In this section, the results for the two training strategies are presented in terms of two aspects: a) the number of signs per set for which trainer assistance was required, and b) the type of assistance, viz. corrections or demonstrations provided.

4.3.3.1 Number of signs requiring assistance

Assistance required was either demonstrations or correction of signs during participant self-practice. For the purpose of comparison, the probe signs (15) taught in a particular theme, were combined with the 15 probe signs from the other theme taught using the same strategy. Thus there were 30 signs per strategy for which assistance scores were calculated for the total of 60 probe signs. It is evident from Table 4.12 which reflects individual participant scores that a high number of signs, more than 60%, had to be repeated by the trainer, as participants could not recall them spontaneously after having learned how to produce them. This high number of signs that needed assistance could have been influenced by the sign characteristics as the majority of signs (73%) were low translucency, while two thirds (67%) of the signs had difficult handshapes (as described in Table 3.7 of the methodology). It is evident, however, that the graphics strategy required less assistance by participants overall, despite two participants (D and R) having scores closely matched for the strategies. (Appendix 41 presents the assistance scores of individual participants across the themes and teaching strategies).

Table 4.12 Number of signs for which assistance was required

Participant	Graphics		Signing-only	
	Frequency (N=30)	Percentage	Frequency (N=30)	Percentage
SG	18	60%	25	83%
D	19	63%	19	63%
SA	20	66%	24	80%
R	21	70%	20	66%
Total	78	65%	88	73%

It is interesting to note that participant SA who had stated that she did not look at the sign illustrations but relied more on the signing, only "peeking" at the sign illustrations (Appendix 36), needed the most assistance overall, and especially in the signing-only condition. This was in spite of the fact that she had the highest number of signs pre-training. SG showed a similar high number of signs requiring assistance, also having a high number of signs pre-training. It could be that these individuals relied more on sign demonstrations than graphics to learn as they had more experience with signs and could take advantage of the cues.

The difference in the extent to which assistance was required for the conditions was explored using the ANOVA. The graphics strategy ($\overline{X}$ = 9.75) required less input from the trainer, than the signing-only strategy ($\overline{X}$ = 11.00), with a significant p-value of 0.03 (p< 0.05). This finding clearly indicates that the sign illustrations provided support in learning to sign. However, the number of signs that were actually produced still appears relatively low, given the fact that the participants were not sign-naïve, and knew a few signs pre-training. The sign illustrations seemed to provide cues that aided the participants in producing more signs independently compared with the list of sign glosses used in the signing-only condition when the sign model was removed. Thus, the sign illustrations could be seen as triggering recall of signs and assisting with sign production in the absence of a sign model. This finding therefore supports the participants' perception that the graphics assisted in the learning of signs. The graphic representation appeared to facilitate recall of signs during self practice. This has long been an assumption in the literature (Cregan & Lloyd, 1990). However, an exploration of the nature of the assistance required provided a clearer understanding of the contribution of the sign illustrations in the sign learning process.

4.3.3.2 Nature of assistance required during sign practice

The nature of the assistance required was explored by looking at whether an additional demonstration of the sign was required or whether a correction of an attempted sign was needed. As there were three phases of practice (as described in Section 4.4.2.1), each sign was observed three times. Thus in a particular theme, with that training strategy, there was a potential total score of 45 (3 x 15 probe signs). For the comparisons of strategies, the probe signs were combined, thus the total scores were out of 90 (45 per theme, two themes per

strategy). The summary of results for the individual participants is reflected in Table 4.13. (Appendix 42 presents detailed results across themes and strategies).

Table 4.13 Nature of assistance given to participants

| Participant	Type of Assistance	Graphics		Signing-only	
		Frequency (N=90)	Percentage	Number (N=90)	Percentage
SG	Demonstration	0	0%	27	30%
	Correction	32	35%	26	28%
D	Demonstration	8	8%	27	30%
	Correction	21	23%	14	15%
SA	Demonstration	3	3%	22	24%
	Correction	24	26%	13	14%
R	Demonstration	6	6%	19	21%
	Correction	25	27%	15	16%
Total	Demonstration	17	5%	95	26%
	Correction	102	28%	68	19%

It is evident that there is a marked difference between the graphics and the signing-only strategies for all participants. Fewer demonstrations were needed with graphics strategy, while both corrections and demonstrations were needed for the signing only strategy. The difference between the types of assistance needed was compared using the ANOVA to determine if there were significant differences between the strategies. The results are reflected in Table 4.14.

Table 4.14 Nature of assistance required: demonstrations

Phase of practice	$\overline{X}$		p-value
	Graphics (N=15)	Signing-only (N=15)	
Practice 1	1.62	7.37	**0.00***
Practice 2	0.50	2.62	**0.00***
Practice 3	0	2.00	**0.00***

* All statistically significant values on the 5% level of confidence are indicated with an asterisk

There were significant differences in the type of assistance required by the participants, in terms of demonstrations versus corrections of signs. It is clear that significantly fewer demonstrations were required for the graphics strategy at all levels of practice (p<0.01). Also, the number of demonstrations decreased as the practice increased as shown in Figure 4.1.

Fig 4.1 Comparison of demonstrations across sign teaching strategies
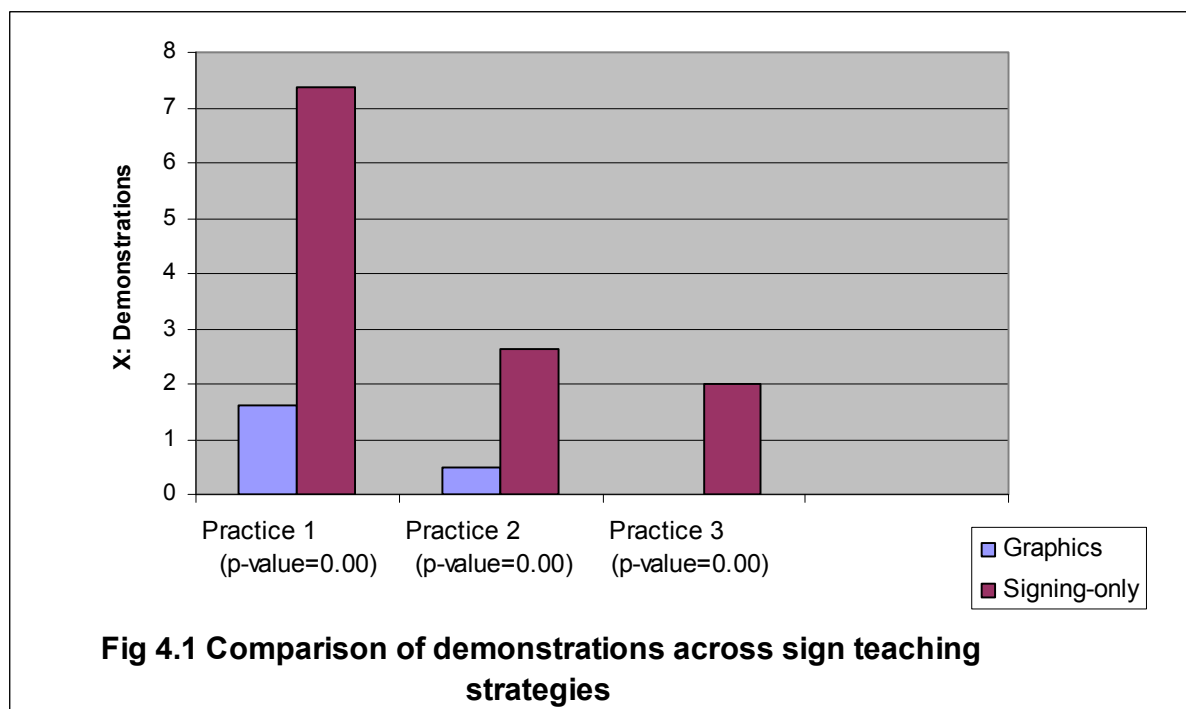
From this figure, it is clear that as the participants continued to practice there was decreased reliance on the trainer, possibly due to access to the graphics which assisted in the recall of signs. This therefore could make the graphics strategy more efficient, as demonstrations continued to be requested with the signing-only strategy.
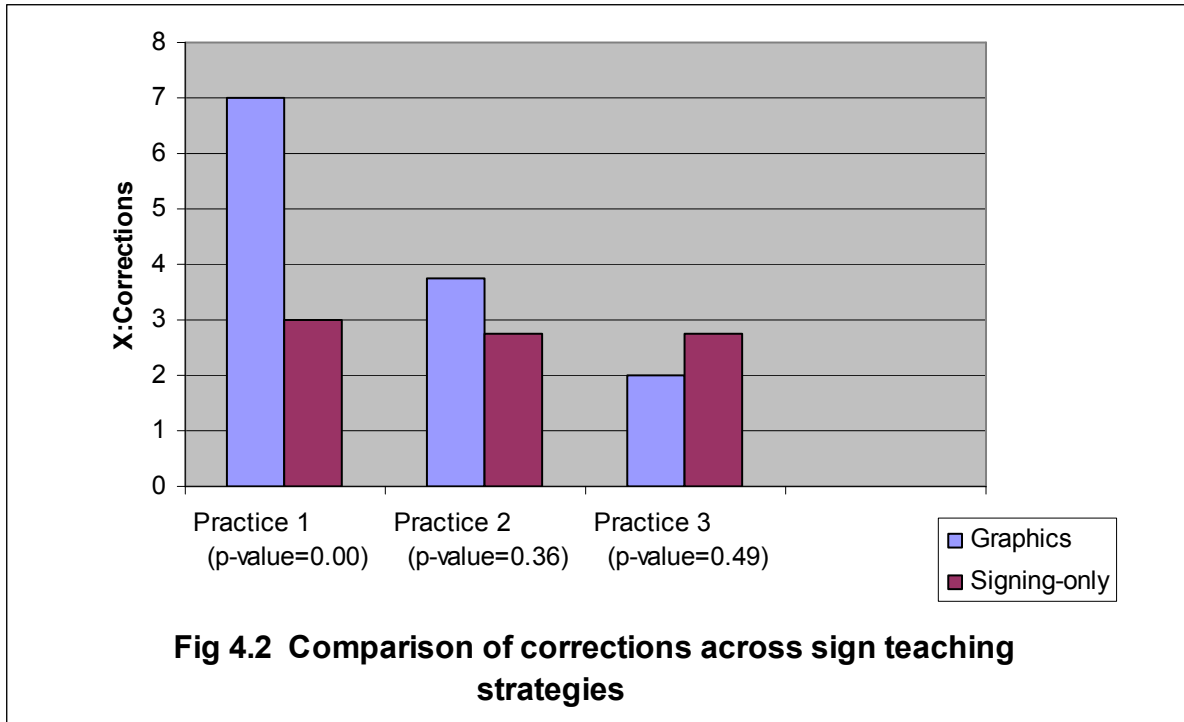
With regard to the correction of signs, there was a significant difference between the strategies only during the initial phase of practice with single signs. The graphics strategy had significantly more corrections as opposed to demonstrations (p-value < 0.01) as shown in Table 4.15.

Table 4.15 Nature of assistance required: corrections

Phase of practice	$\overline{X}$		p-value
	Graphic symbols (N=15)	**Signing only (N=15)**	
Practice 1	7.00	3.00	**0.00***
Practice 2	3.75	2.75	0.36
Practice 3	2.00	2.75	0.49

* All statistically significant values on the 5% level of confidence are indicated with an asterisk

The correction of signing by the trainer for the graphics strategy however, progressively decreased as is evident in Figure 4.2. The higher number of corrections with the graphics strategy appears to indicate an attempt by the participants to produce the sign, using the sign illustration as a cue. With the signing-only strategy, corrections remained relatively constant. This, together with the high number of demonstrations required with the signing-only strategy, led to greater input being required by the participants during self-practice.

X:Corrections

8
7
6
5
4
3
2
1
0

Practice 1
(p-value=0.00)

Practice 2
(p-value=0.36)

Practice 3
(p-value=0.49)

Graphics
Signing-only

Fig 4.2 Comparison of corrections across sign teaching strategies

It appears that with the graphics strategy, as practice increased participants learned to produce the signs accurately by looking at the sign illustration. This did not occur with the signing-only strategy, where increased practice did not influence the number of corrections required. It is therefore evident that the graphics could have served a supportive role in recalling signs, that the written words used in the signing-only condition did not. The interaction of the corrections and demonstrations of signs during the practice phase of sign learning appeared to contribute to the positive impact of the graphics strategy during training. It is interesting to note that this supports the participants' perception (as described in Appendix 37), whereby participants felt that the graphics were more beneficial even though this was not proven in the first sub-aim looking at the acquisition of signs. It therefore appears that the graphics strategy, with multimodal input was beneficial with regard to self learning. The benefit of using multiple modalities, such as speech, signing, speechreading and graphics, including writing in communication has been the philosophical approach of Total Communication. Further the need for a static representation of signs in sign-learning has been a demand in practical applications of individuals learning to sign (Gustason, 1990).

4. 4 Relationship between sign acquisition and assistance with signs

The two sub-aims, as described in section 3.2, were important to assess the influence of graphic displays on the learning of signs. However, only one of the aspects investigated resulted in the finding of the benefit of the graphics strategy in teaching signs. The first sub-aim, which measured the difference in sign acquisition as an indication of the benefit of the graphics, did not translate into superiority of graphics in sign acquisition when looking at the acquisition of individual signs in terms of sign production or sign understanding. There appeared though, to be a tendency towards the graphics strategy on the production of signs as discussed in section 4.4.1.

The benefit of the graphics strategy became evident on the second sub-aim which probed trainer assistance, comparing the two sign teaching strategies. It emerged that the participants performed better and more independently with regard to practising signs with the use of the graphic displays. Significantly fewer signs required assistance from the trainer when the graphics strategy was used. This is perhaps what is reflected in the participants' reports of the graphics strategy being useful, more so than the signing-only strategy in learning to sign. Further, comments relating to the need for graphics together with teaching sign formation indicate the supplementary nature of the graphics when looking at trainer assistance as opposed to redundancy which appeared to influence learning in the initial stages learning to sign. The participants appeared not to rely on the graphics at that stage, but rather on the sign demonstrations. This raises the question about the point at which graphics take on a supplementary role in learning to sign. It was observed that there were progressively fewer demonstrations and corrections with the graphics strategy as practice increased. This was not evident with the signing-only strategy, where corrections and demonstrations continued to be needed, with continued reliance on the trainer.

4.5 Conclusion

The effect of using graphic representations of signs in sign learning was explored by comparing the teaching of signs with either sign illustrations in graphic displays (graphics strategy) or word lists (signing-only strategy). Both sign glosses and the sign illustrations were visual cues supporting sign learning. The two main areas in which the differences were measured were the acquisition of signs, reflected in the first sub-aim of the study, and trainer

assistance that had to be provided during the practice phase, as reflected in the second sub-aim.

The results indicated that there was no superiority with regard to the acquisition of signs post-training in that there were no significant differences between the two sign teaching strategies. There appeared however, to be a tendency with the graphics strategy, for improved sign acquisition scores with regard to sign production. There was not a similar trend with the understanding of these signs with the graphics strategy. Both strategies appeared to work equally well with regard to acquiring signs receptively. There were however, significant differences between acquiring signs receptively and expressively and this applied to both conditions, especially at one week withdrawal. It appeared also that the signs were retained better in the receptive mode with the graphics strategy on withdrawal of training.

The influence of the graphics was however evident during the sign learning process as measured by trainer assistance. With the graphics strategy, significantly fewer probe signs per set required assistance from the trainer to produce them accurately during the stipulated practice opportunities. This indicated the ability of the participants to use the graphic displays to produce signs. Further, this strategy required fewer demonstrations and corrections in order to produce the signs. In addition, the number of corrections and demonstrations decreased over the practice phases, unlike with the signing-only strategy where these continued to be needed. This in effect, meant that the displays played an important role in teaching signs, making for greater independence and perhaps efficiency in participants learning to sign. The fact that participants felt that the sign illustrations assisted with sign learning further supports its use as an aid in learning to sign.

The use of sign glosses, as used in the signing-only condition, is used extensively by Deaf instructors in Sign Language classes with the direct approach to sign learning. Thus it can be seen that sign illustrations may be as powerful in acquiring signs. However, the graphic displays make for greater efficiency in the learning process. It appears that the use of the format of presenting signs in a graphic display can be seen as both an economic and viable method of teaching relevant vocabulary in context.

It must also be noted that parent interviews, the results of which where not presented in detail in the results section, were valuable in placing sign learning in context for the study

population of interest in this research. The information obtained from the pre-and post training interviews, the details of which are presented in the appendices (Appendix 36, Appendix 37 & Appendix 38), highlights aspects of self perception of signing ability, views on sign learning including motivation and expectations, and the sign learning experience generally and with regard to the two training strategies. It appeared that parents were motivated to learn to sign, perceived the need to improve their signing ability, and reported improved signing, albeit to different degrees as well as benefit from participating in the sign teaching project. In this way they contributed to our understanding of the sign teaching strategies in context.

4.6 Summary

This chapter presented the results and findings of the study with regard to the two sub-aims comparing the learning of a core sign vocabulary with and without theme-based graphic displays with regard to the number of signs learned, and the assistance required during the learning. The reliability of the data and participant perceptions were considered. The use of sign illustrations in graphic displays emerged as a viable support aid to sign learning.

CHAPTER 5
CONCLUSION, EVALUATION AND RECOMMENDATIONS

5.1 Introduction

The closing comments on the study are presented in this chapter, providing an overview and conclusion of the research endeavour. The study is examined in terms of both its contribution to the field and its limitations. Recommendations are made with regard to aspects that could be explored in future research, especially within the context of hearing parents learning to sign as part of their children's intervention.

5.2 Conclusion

Parents of deaf children who are dependent on signing also have to sign, to ensure communication mode-match, a perspective well supported by research (Yoshinaga-Itano, 2000; Wallis et al., 2004; Mitchell & Karchmer, 2006). These parents need to not only embrace a visual language which is suited to a visual modality, that is a Sign Language, but also to develop a level of proficiency in it. For many, this is a very difficult task (Christensen, 1986; Swisher & Thompson, 1985; Gregory et al., 1995). The need for special procedures and innovations for teaching hearing parents to sign cannot be overemphasized. This need has been raised in the literature, with methods of sign teaching to hearing parents of deaf signing children a cause for much debate (Grove & Walker, 1990; Gustason, 1990; Moores, 1996; Lane et al., 1996).

There is a paucity of research in the area of sign learning generally with few studies addressing the issue. Information on the actual teaching of signing has been mainly anecdotal with only a few studies on the training of communication partners (Swisher & Thompson, 1985; Spragale & Micucci, 990; Loeding et al., 1990; Grove & Walker, 1990). In the AAC field, the focus has been on the characteristics of signs and their influence in learning signs (Bornstein, 1990; Loeding, et al., 1990; Granlund et al., 1989; Karlan, 1990). The use of visual support aids has received minimal attention, despite acknowledgement of their role in learning. Whilst many commercial resources, for example story books and

posters depicting signs, are available, and sign illustrations are commonly used in the learning of signs, their contribution to sign learning has not been researched.

This study was motivated by the observation of the need in the region of KZN for mothers of Deaf children to learn and to use SASL (Joseph, 1998; Joseph & Alant, 2000; Cohen, 1996). The consideration of a support-aid, suited to a visual medium, lead to the concept of using theme-based communication displays with sign illustrations. However, the main aim of this study was to describe the role of graphic representation of signs (sign illustrations) in the teaching of signs to hearing parents. Two sub-aims were formulated to compare the conditions of sign learning with and without the use of sign illustrations in terms of (a) understanding and producing signs and (b) the amount and nature of assistance required in learning signs.

The results revealed no significant differences between the two sign teaching strategies for sign reception or sign production post-training. It was speculated that the graphic representations used together with the signs, could have been a factor due to redundancy. There were however, significant differences between the strategies in both the amount and the nature of assistance provided during sign teaching. The graphics strategy required significantly less assistance from the trainer, than the signing-only strategy. With regard to the nature of the assistance, significantly fewer demonstrations were required with the use of sign illustrations during practice. Further, the need for demonstrations decreased as the practice increased. With the signing-only strategy however, corrections and demonstrations by the trainer continued to be required. Thus the participants performed significantly better with regard to practicing signs more independently with the use of graphic displays. It appeared that graphics took on a supplementary role during practice. It was therefore evident that the use of sign illustrations supported sign learning. This finding has implications with regard to resources in sign learning from both the perspective of trainer involvement and self learning, and the cost effectiveness of a print medium in learning to sign.

5.3 Evaluation of the study

 The following are considered strengths of the study:

- The framing of the study within an experimental design, firmly addressed the issue of evidence-based intervention. Also, the AATD allowed for comparisons of two strategies in a relatively short period of four training sessions in just four consecutive days. This served both the design requirements and allowed participants access to a short training programme despite their time constraints. The development of equivalent sets, a requirement of the AATD, highlighted and controlled for influences on sign learning in terms of the signs selected for comparisons. This resulted in innovative steps being implemented to acquire translucency ratings for SASL, ratings of performance difficulty of signs, and the rating of sign illustrations which could be of interest to researchers and clinicians using SASL signs.

- The vocabulary in the study was carefully selected for relevance through a series of steps to especially address the vocabulary needs as perceived by mothers of older deaf children. Although mothers were the primary suppliers of the vocabulary within themes, input was also obtained from teachers and the researcher. This was a unique aspect of the study as existing vocabulary lists were not adequate to address the specific needs of this population. Furthermore, the use of themes to meet the needs of communication displays allowed for a range of grammatical structures, other than the typical nouns and verbs. The attention to vocabulary selection which had a direct benefit to the participants enhanced the external validity of the study. This was confirmed by participant views that the vocabulary was highly relevant to their daily living, which has been a contention in general signing courses for parents.

- There was consistency of training across the participants as evidenced by high treatment integrity measures, thus supporting the acceptance of the study outcomes.

- The study embraced the concept of the centrality of visual methods in learning a visual language (Thoutenhoofd, 2003). The use of sign illustrations as a resource in sign learning has been addressed as a viable method despite other modern methods such as those using video and computer technology, as it is cost effective and as a

print medium, an accessible aid to sign learning, especially in developing countries. It must be noted however, that the use of the sign illustrations as a teaching strategy was embedded into a more complex strategy of using a graphic display format and motivational vocabulary, with additional supporting procedures in a teaching scenario approximating signing classes, the impact of which may be synergistic.

- The researcher, who was also the trainer, is a Speech-Language Therapist and Audiologist, and an experienced signer, having worked in the field of aural rehabilitation with children who sign for 15 years, which included three years of full time employment at a signing school for the deaf in KZN. These insights were brought into the development and implementation of the training strategies. However, to ensure objectivity with implementation of procedures and measurement of outcomes, inter-rating procedures were conducted and indicated high agreement.

The limitations of the study:

- While the research design, the AATD, was critical to examine the effectiveness of sign illustrations in sign learning, it placed constraints on the training due to the stringent controls of an experiment. These effects were seen in the limited number of signs that could be used due to the criterion of sign equivalence across the four sets while maintaining the selected themes, thus having an impact on the external validity of the study.

- The design further influenced the evaluation of the signing ability by restricting measures to individual probe signs in the data collection procedure which revealed no differences between the strategies.

- The lack of differences between the strategies could also be attributed to the relatively short period of training which is not typical in sign learning. This period of training met design requirements but could be seen to influence the study outcomes.

- The characteristics of the signs, namely predominantly low translucency signs which were influenced by design constraints, are not typical in introductory sign learning

programmes. This could be considered a difficult task for parents just introduced to sign learning and may have masked differences between the two teaching strategies.

- The provision of many demonstrations and modeling opportunities to parents, designed to strictly control input in terms of the design, could have masked the differences with the strategies especially as these were not sign-naïve participants.

5.4 Recommendations for further research

The following aspects could be explored in future studies:

- Change in the design for application to a group design using a control and experimental group. This would then allow for an increase in the number of signs taught with a particular teaching strategy, as well allow for more in-depth assessment such as sign combinations and rating scales to assess the effectiveness of the graphics strategy.

- To explore more fully the influence of graphics strategy, the assessment could be refined by direct linking of the sign illustration to the manual sign parameters in the training and the evaluation procedures. The sign illustrations themselves could be used to cue both sign understanding and sign production.

- Training over a longer period in a more natural sign learning process. This could involve participants taking the training material home to practice with. This might highlight the impact of having a stronger visual aid to remind parents of the signs taught over a period of time.

- It would be interesting to assess the use of sign illustrations in graphic displays with parents who are African language speakers who speak English as a second language or not at all, and who make up a large percentage of parents at schools for the deaf in SA.

- Theoretical implications which could be explored in future studies include the exploration of the actual cues provided by sign illustrations in learning signs, as well as the representation of signs in memory, from the perspective of a visual language.

5.5 Summary

This final chapter briefly revisited the rationale for the study before presenting a summary of the main findings of exploring the role of sign illustrations within the context of theme-based graphic displays in learning to sign.   The strengths and weaknesses, together with recommendations for future research were presented. The study, it is believed confirmed the priority of exploring more dedicatedly strategies for addressing the need of hearing parents to sign to facilitate their communication with their deaf signing children.