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Original Article

Chaining Strategy and Word Recognition Development among Deaf Pupils in Tanzania

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ABSTRACT

Despite chaining strategy being used in teaching deaf pupils in Tanzania, still deaf graduate with poor reading skills. Thus, there was the need of finding out the reasons for this stressing situation in the country. Basing on the theory of simple view of reading which highlights that reading comprehension is determined by word recognition ability and language comprehension ability, this study explored the contribution of chaining strategy in developing word recognition ability among deaf pupils in selected special primary schools in Tanzania. The study employed mixed research approach with a convergent research design, whereby, in-depth interview, observation, questionnaire and test were employed to collect data from teachers and deaf pupils respectively. A sample of 182 respondents that included 20 teachers and 162 deaf pupils was used. Data obtained were analysed through descriptive, simple linear regression and content analysis. The study revealed that the use of chaining strategy has significant contribution in developing word recognition ability among deaf pupils in Tanzania. This is because the strategy contributed much in building up major word recognition sub-skills among deaf such as, fingerspelling ability, ability to select specific word from the group of written words, abilities to match words with their corresponding signs, and ability to identify misspelled words. In-turn the subskills contributed to word recognition ability among deaf pupils. The study recommends the government to strengthen on in-service training among teachers for deaf as it will keep teachers updated as far as sign language is concern and on how to effectively apply chaining strategy.

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INTRODUCTION

Word recognition refers to the process of visually perceiving a word and immediately identifying its pronunciation without conscious effort (Garnett, 2011). It is a crucial skill for developing reading fluency in individuals (Macalister, 2010). According to the theory of simple view of reading, word recognition plays a significant role in reading comprehension, particularly among children (Cain, 2006). Therefore, it can be argued that word recognition serves as the cornerstone of reading proficiency, and individuals cannot become competent readers without strong word recognition abilities (Cortese & Balota, 2012). However, in the context of deaf individuals, the concept of word recognition shifts due to their inability to associate words with their spoken pronunciation. For the deaf community, word recognition involves the capacity to visually recognize a written word and realize its constituent letters and meaning (Barca et al., 2013).

Developing word recognition skills among deaf children is somehow challenging because it needs teachers who are very creative and committed (Kelly, 2003). Mostly, deaf children learn word recognition skills through visual cues such as visual features of letters and words, line letter shapes, letter combinations, and word patterns (Rowley, 2018). Developing word recognition skills depends on various important sub-skills such as fingerspelling (Miller et al., 2021). Fingerspelling is a technique used in teaching word recognition among deaf individuals by using manual alphabet signs to spell out words letter by letter on the fingers or hand. Fingerspelling provides a visual representation of the letters in a word, which can help deaf learners to better understand the spelling of words and improve their overall literacy skills. Also, word recognition skills development among deaf depends on Sign Language (Holmer & Rudner, 2016). Sign language is the primary mode of communication of majority of deaf children, thus, its use in teaching word recognition help deaf learners make connections between signs and written words (Rudner, 2014).

The common strategy that help in developing word recognition skills among deaf is the use of multisensory approaches (Francisco & Padilla 2023; Knoors & Marschark 2014). Incorporating multiple senses, such as sight and touch, can enhance word recognition skills among deaf individuals (Gentry et al., 2004). Hence, activities that involve visual aids, tactile materials, and interactive learning experiences are said to be beneficial (Marschark & Spencer, 2011). One example of this multisensory strategy used in teaching word recognition among deaf pupils is that know as chaining strategy (Padden & Ramsey, 2000).

Chaining strategy, is one of teaching strategies that involves combining of more than one technique in teaching (Holcomb, 2023). In relation to deaf children, chaining strategy involves fingerspelling a word, pointing to written word and using pictorial support (Holcomb, 2023; Nussbaum et al., 2012). Staden (2013) believes that, the chaining strategy enables deaf pupils to understand letters that make up the word and the differences they cause when the specific arrangement is changed. This is in line with the study by Puente et al. (2006) which found that chaining of fingerspelling, visual pictures and print language enhances literacy skills development among the deaf. This might be one of the reason that influenced teachers for deaf in Tanzania to adapt this strategy because the preliminary interview with 6 teachers of the target schools on 18th December 2022 indicated chaining

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as the most used strategy in teaching reading to deaf in Tanzania.

Despite many teachers applying chaining strategy in teaching word recognition among deaf pupils in Tanzania, still majority of deaf pupils graduate standard seven with poor reading skills (AMUCTA, 2022). This raised a need to check the impact of chaining strategy in Tanzanian context. For that reason, this study investigated on the contribution of the chaining strategy in developing word recognition ability among deaf pupils in Tanzania.

The study objective

This study aimed to determine the contribution of chaining strategy in developing word recognition ability among deaf pupils in Tanzania.

LITERATURE REVIEW

Humphries and MacDougall (2000) highlight chaining of printed or written word, then fingerspelling the word and giving the sign related to the written/finger spelled word as the strong strategy that is used to support the development of word recognition ability among deaf pupils. Padden and Ramsey (2000) indicate chaining strategy as the technique that enables deaf pupils to recognize different word patterns through connecting written words, fingerspelling and signs. Therefore, chaining strategy enables deaf pupils to understand letters that make up the word and the differences they cause when the specific arrangement is changed (Harris & Moreno 2004; Staden, 2013).

This is in line with the study by Herrera-Fernández et al. (2014) that was conducted on 24 pre-lingual deaf children from the public schools in Santiago de Chile on the efficacy of visual strategies for learning and improving literacy skills in pre-lingual deaf readers. The study employed a quasi-experimental design. Its findings revealed chaining strategy as one of the strategies that promoted the improvement of word identification abilities among the participants. This concurs with a longitudinal study by Mayer and Moskos (1998) that used a sample size of 15 deaf pupils. The study reported effective spelling ability among the pupils as the result of the use of combined techniques like exposure to print, sign, and speech. The discussion under this study is also in-line with a qualitative study by Quinto-Pozos and Reynolds (2012) that used 2 deaf children to investigate on American Sign Language Discourse Strategies: Chaining and Connecting. This study found that the use of chaining techniques support vocabulary development and print word recognition.

As well, a quasi-experimental study by Staden and Roux (2010) with 64 respondents revealed chaining strategy as the strong strategy for teaching reading skills. Their study was on the efficacy of fingerspell coding and visual imaging techniques in improving the spelling proficiency of deaf-signing elementary-phase children in South Africa. It found that chaining of fingerspelling, visual picture and print language enhances literacy skills development among deaf. Again, the experimental study with 26 deaf participants by Puente et al. (2006), shows strong link between orthographic skills and use of chaining strategy (fingerspelling skills and visual coding of vocabularies).

Moreover, a single subject research by Subasno et al. (2021) conducted in Indonesia revealed the use of multiplex teaching method (chaining strategy) being effective in helping deaf students to master vocabulary. The study used 2 deaf students to determine the effectiveness of “multiplex teaching method” in mastering vocabulary for deaf students.

All reviewed studies used either qualitative or quantitative approach while quantitative studies used either quasi-experimental or experimental design. None of the reviewed study employed mixed research approach in studying the contribution of chaining strategy in developing word recognition ability among deaf children. Thus the reviewed studies believed that there is only on one way of understanding chaining strategy and word recognition ability among deaf children. On the other hand, none of the reviewed studies used teachers as their respondents in trying to understand the contribution of chaining strategy

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in developing word recognition ability among deaf children. Thus these studies did not recognize teachers as key players of developing word recognition ability of deaf children through chaining strategy. Each of the reviewed study used less than 65 participants the number that might not be enough for generalization because generalization studies need large number of participants.

Also, the reviewed studies show that deaf pupils are needed to develop sign language skills before developing word recognition ability. However, the study was not sure if this was being considered in Tanzania when teaching word recognition to deaf pupils. Likewise, none of the reviewed literature explained the contribution of chaining strategy in developing word recognition ability among deaf pupils in Tanzania. This showed the need of having this study conducted in Tanzania.

METHODOLOGY OF THE STUDY

This study applied a convergent research design under a mixed research approach to explore the contribution of chaining strategy in developing word recognition ability among deaf pupils from selected primary schools in Tanzania. Purposive sampling technique was employed in selecting the research area and teachers for qualitative part of the study. Simple random sampling technique was used to select deaf pupils and teachers for quantitative part of the study. A total of182[1] responders were used in this study, whereby 162 were deaf pupils from standard one, two and three in the selected primary schools for deaf in Tanzania and 20 were teachers teaching in those selected schools. The fishbowl technique was used in selecting deaf pupils and teachers for quantitative part of this study while saturation of information determined the sample size for qualitative aspect. Thus the qualitative sample size was made up of 12 teachers who were among the 20 respondents under quantitative aspects.

Questionnaires were used to collect quantitative data from teachers on the contribution of chaining strategy in developing word recognition abilities among deaf pupils from 20 teachers from the four selected special primary schools for deaf in Tanzania. The questionnaires were prepared and interpreted into the language that is well known to the respondents. Also, a test designed by the researcher was used to collect data on word recognition abilities among standard one, two and three deaf pupils from selected primary schools for deaf in Tanzania. The test was administered to deaf pupils by the researcher in collaboration with sign language interpreters who were used in interpreting the instructions of the test. As well, in-depth interview was used to collect data from 12 teachers teaching in the four selected primary schools for deaf in Tanzania. Similarly, the study employed participatory observation that was used to observe deaf pupils' word recognition abilities and on how teachers applied chaining strategy in teaching deaf pupils.

In this study, validity of the tools of the study was ensured by some experts from Department of Special Needs Education to assess the relevance of the research and tools content that were used in the interview and observation guide as well as questionnaires and test. The Cronbach's alpha was used to measure if a group of items in the data collection tools consistently measured the same characteristic through showing their level of agreement. Cronbach's alpha value of 0.713 was obtained, thus it indicated the elevated level of agreement among the items in the research tools because the Cronbach's alpha value of 0.7 was regarded as the minimum acceptable value.

The quantitative data on the contribution of chaining strategy in developing word recognition ability among deaf pupils were analysed by using both descriptive and inferential statistics analysis through the software program of Statistical Package for Social Sciences (SPSS) version 20.0.

[1] This was calculated by using the formula suggested by Yamane in 1967 that is n = N/(1+Ne^2). Whereby: n = sample size, N = population size, and e = Margin of error (MoE). The study used margin error of 5% or 0.05. Since the total number of targeted populations for quantitative part of this study was 334 teacher trainees, the sample size was calculated as follows:
$n = \frac{334}{1+334(0.05)^2}$; $n = \frac{334}{1+334(0.0025)}$; $n = 182.02$; Thus $n \approx 182$

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The simple linear regression helped to determine the contribution of chaining strategy in developing word recognition abilities among deaf pupils. On the other side, the qualitative aspects on the contribution of chaining strategy in developing word recognition ability among deaf pupils from selected primary schools in Tanzania was analysed through thematic content analysis by checking inner meanings of the data from in-depth interview with 12 teachers. This was done by analysing individual words, sentences and paragraphs to get their meanings, data with similar meaning were grouped together into themes. The qualitative data were presented in short narration with quotations from the interview.

FINDINGS AND DISCUSSION

The quantitative findings were presented in table of frequencies and percentages. Qualitative findings were presented in short narrations with quotations from interview and descriptions from observation. Findings from a number of other studies related to the current study were used to validate the findings.

The study intended to examine the extent to which chaining strategy contributes in developing word recognition ability of deaf pupils in Tanzania. In responding to the study, teachers were requested to rate the contribution of chaining strategy in developing sub-skills important for word recognition among deaf pupils. The rating was done on the questionnaires with five Likert scale ranging from very poor to excellent. Teachers were also involved in the interview sessions where they were given chances to express their views on the contribution of chaining strategy in developing word recognition ability of their deaf pupils.

The study findings revealed high contribution of chaining strategy in developing word recognition ability among deaf pupils in Tanzania. The details are well presented in table I showing respondents' rates on contribution of chaining strategy in developing word recognition ability of deaf pupils through various sub-skills. The sub-skills included fingerspelling, matching words with their corresponding signs, identification of specific words and identification of misspelled words.

Table 1: Respondents Ratings on Chaining Strategy's Impact on Word Recognition among Deaf Pupils

Statements	Very Poor		Poor		Fair		Good		Excellent	
	F	%	F	%	F	%	F	%	F	%
Fingerspelling ability	0	0	1	5	1	5	5	25	13	65
Matching words with their corresponding signs	0	0	0	0	2	10	8	40	10	50
Selecting specific word from the group of words	0	0	0	0	4	20	8	40	8	40
Identifying misspelled words	2	10	5	25	7	35	6	30	0	0

Source: Field data, (2023) F = Frequency

Study findings as indicated in Table 1 show that majority 18 (90%) of the teachers presented that chaining strategy had worthy contribution in developing fingerspelling ability of deaf pupils which is one of the sub-skills that determine word recognition ability. This implies that, most of the deaf pupils in the selected schools are good in fingerspelling due to the use of chaining strategy in teaching and learning process. Likewise, study findings indicate that many teachers are using chaining strategy in imparting fingerspelling skills to the deaf. The findings are congruent with Haptonstall-Nykaza and Schick (2007) who found that chaining strategy that used lexicalized fingerspelling, signs, and English vocabulary to teach deaf students new words enhanced deaf pupils' fingerspelling competency.

The above findings on the contribution of chaining strategy in developing deaf pupils' fingerspelling ability were further supported by responses from interview. Interviewees'

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responses revealed that the use of chaining strategy in teaching reading skills to deaf led to many pupils being competent in fingerspelling. This is exemplified with a response from one of the respondents who was quoted saying:

> *I appreciate chaining strategy. It has helped me in teaching deaf different skills such as fingerspelling in my class. From that, most of my deaf are good in fingerspelling and they can tell components of different words through finger spelling. On the other side, there are some who fingerspell with difficulties. Sometimes they misspell or others forget some letters making up the words.*

Another teacher respondent highlighted that:

> *Through the use of chaining strategy, the deaf have been capable of breaking words into their component letters through fingerspelling. Although, fingerspelling is among the skills that deaf master easily and very fast but chaining strategy has made it the easiest skill. When you show a word to deaf in my class and you direct them to fingerspell it, they do it at very high speed. For that matter, I have no problem with fingerspelling skills of my deaf students.*

These interview responses show the extent to which teachers are confident in the use of chaining strategy. Also, the study findings indicate how teachers believe that their pupils are competent in fingerspelling due to the use of chaining strategy in teaching process. The interpretation of this is that, teachers usually use chaining strategy in teaching literacy skills to deaf and they don't regret using the strategy. This study results tally with the findings from the study by Stone et al. (2015) who discovered that the use of chaining strategy in teaching reading skill to deaf promoted the development of fingerspelling, sign language, and orthographic decoding skills which in-turn facilitated the development of reading skills.

It was observed that when deaf children were tasked to fingerspell words, they did it well and quickly at high speed. In all schools that were visited for data collection and all classes that were involved in this process, students were good at fingerspelling. They did not need a lot of instructions or repetitions to understand the task. Furthermore, the study observed that teachers used chaining strategy in their classes. This was noted when teachers were teaching different vocabularies, they started by showing the word on the cards or board followed by the fingerspelling of that word, then showing the sign representing that word/concept and finally showing the picture or real object of that word. This was not a two minutes' process, rather it took four to six minutes for one vocabulary. Therefore, the witnessed fingerspelling competency among deaf pupils in this study has been contributed by the use of chaining strategy.

Moreover, study findings show that almost all teacher respondents 18(90%) as indicated in Table 1 believed that chaining strategy had notable contribution to the development of deaf pupils' competency of matching signs with their corresponding words. On the other hand, none of the teacher respondents had negative opinions about the contribution of chaining strategy in developing deaf pupils' ability to match signs with their corresponding words. This suggests that, deaf pupils from selected schools were competent in matching signs with their corresponding words as one of the strategy for word recognition among deaf pupils. The findings are parallel with Nussbaum et al. (2012) who pointed out that, one of the techniques and strategies that can help deaf children link between sign and spoken or written language is chaining strategy.

The above findings on the contribution of chaining strategy in developing deaf pupils' competency of matching signs with their corresponding words are in-line with the interviewees' responses. From the interview it was reported that chaining strategy had positive impact to deaf pupils' competence of matching words with their corresponding signs. For example, during interview with teachers, one of the respondents was quoted saying:

> *Through the use of chaining strategy, the deaf have been capable of matching the written*

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> *words with their corresponding signs. I usually make sure that their class is full of well labelled picture as they help in making association with relevant sign.*

Another teacher respondent was quoted saying:

> *As I replied before, majority of the deaf students in standard IB are good at matching signs with their corresponding words as the impact of the use chaining strategy when teaching them. For example, when you sign and tell them to select the card with the word corresponding to the given sign almost 88% of them can do that without hesitating.*

Study findings through interview indicated that, deaf pupils recognize different words and their meaning, that makes many of them match the shown words with their corresponding signs. It was also noted that sign language knowledge is very important for deaf pupils to learn reading skills. Additionally, interviewees responses show that teachers depend on chaining strategy in developing deaf pupils' ability to match words with their corresponding words. This aligns with the findings by Padden and Ramsey (2000) who found that teachers used chaining strategy in helping deaf students to connect written words with their signs.

Deaf children were observed to have no problem with the skill of matching signs with their corresponding words. Student respondents were very active when performing the test related to matching of words with pictures or signs. The classes used by deaf students were observed to have a lot of well labelled visualization materials. During break time students were asked to give signs from labelled picture and it was very interesting as most of them demonstrated a correct matching ability. In class sessions, literacy teachers were observed applying chaining strategy by signing, fingerspelling, pointing on the picture and demonstrating or imitating different animals. Others even used their tablets to show short videos related to concepts that they were teaching. Thus, there is no doubt that teachers used chaining strategy in teaching deaf and that it contributed in developing pupils' competency of matching words with their corresponding signs. This is supported by Humphries and MacDougall (2000) who underlined that the use of chaining strategy when teaching reading skills helped deaf pupils to develop the ability to associate real-world objects or pictures, signs, finger-spelled words, with written words.

Furthermore, study findings as indicated in Table 1 discloses that most of teachers 16(80%) graded the contribution of chaining strategy in developing deaf pupils' ability of identifying specific word being prominent. The findings are supported by Quinto-Pozos and Reynolds (2012) who found that the use of chaining strategy supported vocabulary development and print word recognition. Likewise, the current findings are in favour of the study by Puente et al. (2006) which found that chaining strategy influenced the development of the skill to map individual vocabularies as well as orthographic skills among deaf children. This predicts that, high percent of deaf students were good in recognizing the specific word from group of words as the result of applying chaining strategy. As well, study findings imply that chaining strategy influenced teachers for deaf to make their students understand components of words in such a way that they were capable of differentiating one word from the other.

In the same way, the findings were supported by responses from interview which show that majority of deaf pupils were competent in selecting specific word from the group of words. This is exemplified from a response from one of the respondents who said:

> *Chaining strategy has made it easy for deaf students to differentiate the certain word from groups of words written either on the board or cards. I usually show a word on one card in my hand and tell the class or individuals to select and give the similar word from the group of words collected together or to cycle such word on the written paragraph the do it without problem.*

Through the use of observation method, the study found that teachers used learning games to assess

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deaf pupils' ability to identify selected words from a group of words. For instance, in one of sampled school the teacher had prepared word cards which were placed inside the box and students were told to select a word similar to that written on the board from the box. Sometimes, they were given a sign and tasked to select the word being represented by the given sign.

Again, table I presents varied opinions from teachers on the contribution of chaining strategy in developing deaf pupils' competency of identifying misspelled words. Study results show that majority of the teachers indicated that chaining strategy had average contribution in developing deaf pupils' competency of identifying misspelled words. This was partly in link with Harris and Moreno (2004) who argue that, chaining strategy helps the deaf in learning spelling through cleating visual memory of the word, by linking the written word with its fingerspelling form, sign and how it is pronounced though lip reading. As well, the study findings do not well align with the study by Berke (2013) who highlighted that the use of chaining helped in making deaf students understand spelling difference between two similar-looking words. The findings are contrary to Mayer and Moskos (1998) who established that, the use of chaining strategy led to effective spelling development in deaf children as use visual-spatial information when recalling how to spell a word. The implication of this is that, teachers might have had not trained their students on identifying misspelled words. This is from the fact that, if deaf students are not given clear instructions and clarification they might think that it was a new vocabulary and not a mistake.

The study findings were also supported by responses from interview which show that majority of deaf pupils were partially competent in identifying misspelled words. This is exemplified from a response from one of the respondents who said:

> *Noticing the misspelled words is somehow tricky and difficult to deaf students I am teaching. Through chaining strategy and word cards, I have been trying now and then to make sure that they can differentiate a word with correct spelling from that with spelling error, unfortunately it is still difficult to some of them. But there are others who show wonders on that in some days, but the other days the problem continues. I really, fell to understand what happens to such students.*

The findings on the contribution of chaining strategy in developing deaf pupils' word recognition ability were further supported by the findings from the test administered to deaf pupils. The test intended to prove deaf pupils' word recognition abilities as one way of confirming teachers' responses on the contribution of chaining strategy in developing word recognition among deaf. The results are well summarized in Table 2.

Table 2: Deaf Pupils' Test Results on Word Recognition Ability

Word recognition ability	Frequency	Percent (%)
Not capable	2	1.2
Very poor	3	1.9
Poor	4	2.5
Fair	14	8.6
Good	21	13
Very Good	118	72.8

Source: Field data (2023)

Study findings as indicated in Table 2 revealed that, chaining strategy used in teaching deaf pupils had high impact on their word recognition ability. This is due to the fact that, more than three-quarters of all pupils involved in this study were competent in word recognition. This is in line with the study by Herrera-Fernández et al. (2014) that revealed chaining strategy as one of the strategies that promoted the improvement of word identification abilities among the participants. The

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study findings by Quinto-Pozos and Reynolds (2012) which found that the use of chaining technique among deaf supported vocabulary development and print word recognition, give further validation of results under this section.

To clearly understand the impact of chaining strategy in developing word recognition among deaf pupils, the study performed a simple linear regression analysis. Simple linear regression was used to prove study findings on the contribution of chaining strategy in developing deaf pupils' word recognition ability that were presented descriptively and thematically. The results from regression analysis show that chaining strategy affect word recognition ability among deaf pupils by 77.7%. This is shown by Table 3 which shows R^2 of 77.7% and the Adjusted R^2 of 0.764.

Table 3: Model Summary of Chaining Strategy and Deaf Pupils' Word Recognition Ability

Model	R	R Square	Adjusted R Square
1	.879[a]	.777	.764

a. Predictors: (Constant): Contribution of Chaining strategy in developing deaf pupils' word recognition ability

Moreover, statistically, the results show significant relationship (p = 0.000) between the use of chaining strategy and the development of word recognition ability among deaf pupils. The relationship is said to be significant because the obtained p value is within the recommended range (0.05 or less than that). Therefore, this helps to conclude that, the manifested word recognition competencies among the deaf pupils originated from the use of chaining strategy in teaching literacy skills. Table 4, gives more details about regression results.

Table 4: Contribution of Chaining Strategy in Developing Word Recognition Ability among Deaf Pupils

Coefficients[a]

Model		Unstandardized Coefficients	Standardized Coefficients	
		B	Beta	Sig.
1	(Constant)	.490		.281
	Contribution of Chaining strategy in developing deaf pupils' word recognition ability	.840	.879	.000

a. Dependent Variable: Deaf pupils' word recognition ability

Generally, the study has found that the use of chaining strategy in teaching reading skills to deaf pupils has substantial contribution in developing word recognition ability among deaf pupils from selected special primary schools in Tanzania. This is revealed in teachers' responses and results from deaf pupils' test as well as from observation. The simple linear regression results analysed under this objective, confirmed that the use of chaining strategy in teaching reading skills to deaf contributed to the development of word recognition abilities. This was shown by a significant relationship between the use of chaining strategy and development of word recognition ability among deaf

CONCLUSIONS AND RECOMMENDATIONS

The results of this study revealed that the use of chaining strategy in teaching reading skills to deaf pupils has significant contribution in developing word recognition ability among the pupils from selected special primary schools in Tanzania.

The strategy contributes much in building up major important word recognition sub-skills among deaf, like fingerspelling ability, ability to select specific word from the group of written

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words, abilities to match words with their corresponding signs, and ability to identify misspelled words. In-turn the subskills contribute to word recognition ability among deaf pupils.

The study recommends the government to strengthen on in-service training among teachers for deaf. This will help in making sure that teachers for deaf are competent in sign language as well as on how to apply chaining strategy in teaching deaf pupils in Tanzania. The study further recommends on conducting another research on the contribution of chaining strategy in developing word recognition ability among deaf pupils in inclusive schools in Tanzania.

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