Articulatory Response

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ARTICULATORY RESPONSE OF CEREBRAL PALSY STUDENTS IN UTTERING CONSONANT SOUNDS

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Abstract

Speech mechanism involves brain in order to organize the speech apparatus to produce the sounds, especially consonants. The incomplete coordination of brain and muscles of the speech apparatus have an effect on the process of articulating the speech sounds. This research focuses on how the students' articulatory response on the consonant sounds in words. The data are words taken from the observation and test to the two students who have cerebral palsy in the special needs school. The theory of response type articulation (Davidson, 2006) becomes the foundation of analysis. The result shows that the responses are correct, deletion, segment change, and mix types. Some of these types give the co-articulation effect that also reflects on the duration in their articulation. Therefore, it implicates that the students need certain accommodations to make them able to communicate well.

Keywords: speech mechanism, speech apparatus, consonants, articulation, accommodation

INTRODUCTION

Brain plays an important role in verbal communication (Clark, et al., 2014) because it has language software that gives rules and displays. Children with cerebral palsy (CP) have problems in speech, language, and communication (Pennington, 2008). This happens because there are parts of their brain that is malfunction: the small brain (cerebellum) that contributes to learning, thinking, and speaking. It is involved in the implementation process of the production of speech sounds (Carey, et al., 2014). In addition, children with cerebral palsy will experience a nerves system dysfunction that affect the ability of vision, hearing loss, osteoporosis, learning disabilities, reduced intelligence, posture problems, and age (Goldstein, 2004; Pahwa, 2012).

This disorder with low intelligence happens to some children, not all. It is estimated that more than half of people with Cerebral Palsy (CP) has average and above IQ scores. It is known that individuals with athetoid type of CP have higher IQ scores (Willard-Holt, 1998).

Disruption on the organs of speech causes disrupted speech sound production. This articulation disorder process is called articulation error. This error is related to the process of phonetic phonological process, so it will involve a response that varies from one CP individual at the time the individual is given stimulation to speak. The variation appears when a CP individual tries to communicate with other people.

This study is an adaptation of the focus of previous study: the articulation errors in children with cleft palate (Albustanji, et al, 2014). The focus of study is expanded to reach the problem of articulation responses that cause coarticulation in the duration of the utterance response in words when individuals with athetoid CP do imitations. The results are expected to provide information that supports accommodations of CP individuals, especially athetoid type, so they are able to communicate well.

THEORETICAL FOUNDATION

The Relationship between Phonetics, Phonology, and Articulation

The ability of sounding speeches involves phonetics and phonology. Phonetically, articulation capability is indispensable because it relates to speech sound production process that drives certain speech organs. Phonologically, the speech sound production process under the coordination of the brain has a cognitive role to inform how are speech-sounds displayed, stored, planned, and obtained (Clark, et al., 2013). Speech sound abilities can be categorized as articulatory (i.e., phonetic) or phonological (i.e., phonemic) in nature. Specifically, articulation refers to "motor processes involved in the planning and execution of sequences of overlapping gestures that result in speech" (Bauman-Waengler, 2004, p. 2). In contrast, phonology refers to cognitive/linguistic processes involved in how speech sound information is represented/organized, stored, planned and retrieved (Bauman-Waengler, 2004). It is possible for children to exhibit both articulatory and phonological speech sound errors (Bauman-Waengler, 2004) (Clark, et al., 2013:325)

The process of speech involves the process of breathing, phonation, resonance, and articulation. Respiratory process is the setting of air input and output. Air pushed out by the lungs through the vocal cords. Then, it is channeled to the oral cavity or the nasal cavity. Phonation is the process vocal cords vibration to produce sounds. The resonance is the process of transforming the air that comes out and has passed the vocal cords, by the movement of the jaw, palate, lips, and tongue. The movement is called articulation that produces consonants and vowels (Pennington, 2012). *"Acoustic analysis was used to examine whether speech errors involve lexical, segmental, or sub-featural errors in speech production… Speech errors have traditionally been used to provide evidence for models of speech production that utilize the constructs of linguistic theory as psychologically real components of linguistic performance"* (Frisch, 2002: 139).

Articulation requires the performance of the organs of speech from the outer (two lips) and deepest (lungs). The organs of speech that are very important include the tongue, as well as the lower lip. Tongue impedes the air that comes out and passes through the vocal cords to be modified into a wide variety of sounds. This organ is also a set of air expenditure into the oral cavity or nasal cavity.

Tongue also performs the counteraction process to produce consonant sounds that need counteraction variations. Generally, consonants show greater constriction of the vocal tract than vocalic sounds and have less Prominence (Clark & Yallop, 1990: 75). These counteraction variations are adjusted to the target points of articulation: upper lip, upper teeth, alveolar, palatal, velar, or glottal. The tongue and lower lip, which serve as articulator, participates in the process of articulation. The consonants resulted from the points of articulation, that are targeted by the two articulators, will have certain characteristics. These characteristics are features of the air coming out at the time of the tongue or lower lip touches the points of articulation. The features of the air that come out are the peculiarities of consonant segments. The distinctiveness covers plosives, nasals, fricatives, affricates, and approximants. Thus, the consonant identification is done by differentiating vibrating vocal cords (voiced/voiceless), the points of articulation, and the feature of the articulation results (Alwan et al., 2011) because these three elements can analyze the articulation of consonant sounds. However, individuals with cerebral palsy have a different process. These individuals may be difficult in doing such process.

Type of Response and Articulation in Consonants and Errors of Articulation

Phonetic and phonological factors play role in articulating speech sounds. "*A widely held assumption in phonology is that phonology should be phonetically grounded. Under a strict version of this view, productive phonological processes that counter phonetic naturalness should not be possible*" (Coetzee & Pretorius, 2010: 404). In addition, Chen (2011: 612) says that, "...*we will explore whether the phonological system of one language, i.e., the co-occurrence of consonant and tone, which diachronically is often traced back to phonetic naturalness and synchronically indicative of the phonological contrast system of a language, may in turn relate to the phonetic interaction of consonant*".

Articulation relates to the duration and eloquence (Tumanova, et al., 2011). According to Davidson (2006), when someone articulates speech sounds, the speech responses type will be varied. The type of the response can be correct, insertion, deletion, prothesis, segment change, and combined. On the other side, the duration of the spoken word will be varied depending on the features of the word, e.g. phonological segments or syllables (Baker, et al., 2011)

Type of correct responses is when a particular word uttered without any change in pronunciation. As with the other types, words uttered insert schwa / ə / (Insertion), the first phoneme or both (deletion) is eliminated, schwa is added before the first phoneme (prothesis), is replaced with another phoneme, or a combination of these responses.

Articulation errors arise from the response, for example by the insertion, deletion, prothesis, segment change, or the combined type (Davidson, 2006). This is because of removal, addition, or presence of a new form of pronunciation of the words uttered.

Athetoid Brain Paralyzed

Cerebellum contributes and selectively involved in the control process of articulation in verbal memory within phonological environment. Visual input is translated into phonological representation to be stored. Auditory input has direct access to the stored verbs that it does not require translation again (Carey, 2014). However, if the hearing is impaired, the direct input will be hampered. It causes articulation errors. "*Children with CP suffer from multiple problems and potential disabilities such as mental retardation, epilepsy, feeding difficulties, and ophthalmologic and hearing impairments*" (Jan, 2006: 123). In addition, Russman & Ashwal (2004: 47) agrees that "...*children with CP may have associated deficits of mental retardation, ophthalmologic and hearing impairments, speech and language disorders and oral-motor dysfunction, screening for these conditions should be part of the initial assessment*".

Meanwhile, lame of brain with athetoid type is often associated with complication problem within months before and after birth, other than that is caused by kernicterus and basal ganglia dysfunction. "*Athetoid (dyskinetic) cerebral palsy is most often considered to be associated with serious perinatal complications,1 in particular with sudden and severe birth asphyxia in term infants.2 Kernicterus, a previously common cause of athetoid cerebral palsy, is now rare in Western countries. Athetoid cerebral palsy accounts for 5 to 10% of all cerebral palsy2,3 and is characterized by dysfunction of the basal ganglia leading to impairment of the postural reflexes, arrhythmic involuntary movements, and dysarthria, with sparing of sensation, ocular movements, and often intelligence*" (Amor, et al., 2001: 793).

Kernicterus is brain damage due to jaundice in infants. This damage results in CP and impaired hearing function as well as learning difficulties. Meanwhile, basal ganglia dysfunction causes impaired vision, uncontrolled movements and may result in lower levels of intelligence. The basal ganglia are in the middle part of the brain, which controls movement.

With this consideration, the handling of CP individuals needs, not only medically but also practically, multi-disciplinary therapy. As stated by Pahwa (2012) that multi-disciplinary treatment will greatly assist CP athetoid individuals to interact.

METHODS

This study describes the response of CP athetoid individuals with consonant sounds. Subjects of this study are two students of Disable School in Bandung. They are female. Both participants are fourth grader, equals to seventh grade in ordinary school. The first subject (SC), aged 17, has athetoid CP with additional disturbances in the hearing. This is because jaundice that was experienced when she was a baby. The second subject (SL), aged 15 years, has athetoid CP with additional disturbances in vision, caused by a dysfunction of the basal ganglia. Both subjects have distinctive characteristics relative to the movement of the hands, feet, body position, and certain tools, such as the tongue and jaw.

The data are in the form of words. The words are pronounced with consonant initials. The words are used as the data because they have phonetic variation and this variation will be adjusted to the existing context (Bybee, 2004). If a word is articulated, it will form the relationship among sounds, as results of the transition point of articulation involved in the production process of sound. Therefore, the characteristics of the target speech pronunciation are changed to be similar to the sounds produced later (Di Canio, 2012). Words manifest many phonetic variants due to the context in which they are used. Position in the phrase, contiguous segments and prosodic features, and even the frequency of surrounding words may influence their exact phonetic realization (Bybee, 2004: 142).

The data is gained from the observations and the tests. The observations were performed during the five meetings of teaching. Each meeting lasted two hours and a half. The learning process was recorded. Teaching and learning process are mixed so that students are able to interact with the atmosphere. The teaching process combines academic and student creativity. At its core, it is to motivate students to interact so that teachers lead students to be actively involved in the learning process, for example by playing puzzles, making crafts, and games. The teacher also plays role as therapist to continue stimulating students to talk so that the muscles of speech organs will be trained.

The test is to mimic the pronunciation of some words displayed as a reading test. In addition, stimulation in the form of colorful pictures was given to attract the attention of the subjects so that they are motivated to respond. Tests were carried out at the end of the meeting and the tests were recorded.

Having collected from a number of video, data transcribed, grouped, displayed, analyzed, interpreted, and concluded. The transcription is focused on words that contain consonant. The writing of the words is then accompanied by phonetic transcription. After that, the data were grouped by ownership and the characteristics of consonants appeared into tables. The results were analyzed by analyzing the related theories that led to the interpretation to answer the problem of research. Finally, the conclusions were derived from the implications of the results of interpretation.

FINDINGS AND DISCUSSION

The findings of this study is to answer the question, namely how the response of CP students of the words that contain the initial consonant phonemes, and the impact of what is happened on the response to the pronunciation of words that contain the initial consonant phonemes. Based on research data obtained, by the CP students' responses to the initial consonant phonemes are varied. Both subjects gave responses to the pronunciation of the initial consonant bilabial, alveolar, palatal, velar, and glottal.

Bilabial initial consonant consists of words that recite the initial phoneme /p/, /b/, and /m/. The phoneme /p/ is contained in four words; the phoneme /b/ is contained in seven words; and the phoneme /m/ is contained in four words. The specificity of bilabial consonant phonemes is that the phoneme is pronounced by moving the articulator (lower lip) to get to the upper lip. This articulation is to inhibit the air out through the mouth, after passing through the vocal cords. The air will come out on hold first by the density of the upper lip and lower lip before the air is out with plosive.

Both subjects have relatively varied ways when pronouncing the words. The first subject almost hardly articulates bilabial consonant phonemes, while the second subject is able to articulate them although there is missing or replaced phonemes in words. These variations occur because of the manner of articulation is hampered by CP interference so that the existence of phonemes in transition. The transition is that the subject 1 removes initials bilabial consonant phonemes, whereas the subject 2 only slightly undertake the removal of phonemes. The subject 2 is still able to perform the articulation to pronounce the phonemes.

Initial alveolar consonant responded by the CP students are phonemes /t/, /d/, /s/, /n/, /l/ and /r/. The consonant phonemes /t/ and /d/ is alveolar consonant with the articulation process involving alveolar articulation point located at the rear of the gum of the upper teeth. Phonemes /s/, /l/, and /r/ are the post-alveolar consonant. It means that the targeted articulation point is the back of the gum of the upper teeth but the tongue touches edges deeper than alveolar consonant position. Both groups of consonants are resulted from the manipulation of air escaping into the oral cavity because of the phoneme /n/, although this phoneme is alveolar post. However, the air is out-flowed into the nasal cavity, so that the speech becomes a buzzing sound.

Both subjects do the phoneme removal and replace it with another phoneme when they pronounce words that contain alveolar consonant phonemes.

A palatal consonant in the Indonesian language is the phoneme /j/. The consonant are produced by articulating the tongue to touch the palate. The tongue touches the palate to obstruct the air that

passes out of the oral cavity, so that the air is suspended and then is released all at once. Both of the CP students show that the phoneme /j/ is not pronounced. This happens because they are not able to touch the palatal area.

Of the three types of existing velar consonants, /k/, /g/, and /ŋ/, both subjects perform /k/ and /g/ in the initial position, while /ŋ/ is displayed in the final position. The phoneme articulation process is when the body of the tongue touches the velar articulation point to block the air that comes out through the mouth. The air is hold before later is made plosive. Meanwhile, the phoneme /ŋ/ is a consonant that is produced by the process of articulation in the nasal cavity. A result of the air that comes out has the same feature with the features of consonants /m/ and alveolar /n/. Although they have different points of articulation but they have similar properties of articulation. However, based on data that is displayed, the two CP subjects perform phonemes by removing and replacing it with another phoneme.

Glottal consonants produced from articulation process involving the articulation point of the glottis. This has a specific fricative sound on the air. Both subjects do not pronounce glottal consonant phonemes. This occurs because the removal of phonemes because of CP disruption.

Both subjects perform activities of phonological variation resulting from articulatory disorder that occurs in an articulator. Articulator that consists of the lower lip and the tongue are not able to touch the points of articulation accurately. These factors trigger reduction, addition, and replacement in pronounce certain speech sounds within sample words.

Articulation Response Types in Pronunciation of Initial Consonant Phonemes

Articulation response conducted by athetoid CP students for the words with initial consonant. The types cover bilabial, alveolar, palatal, velar, and glottal. The responses consist of correct, deletion, segment change, and mixing. The following is an explanation of each response.

Correct

This response occurs when subjects successfully pronounce phonemes as appropriate articulation process, such as bilabial initial consonant /b/ in the word ‘bawa’ (take). Subject 2 is able to pronounce the word with [bawa].

Deletion

Deletion of consonant phonemes is performed on the first phoneme or first and second phonemes. The following are the examples.

Dua	/dua/	/a:/	(S1)
Dua	/dua/	/u’a:/	(S2)
Ria	/ria/	/i’a:/	(S1)
Habis	/habis/	/abis/	(S2)
Nama	/nama/	/ama/	(S2)

Other than one or two phonemes at the beginning, deletion also occurs at the beginning and the end or beginning, middle, and end. The following are the examples.

Tomat	/tomat/	/o’ma:/	(S2)
Tujuh	/tujuh/	/u:’u:/	(S1)

Deletion also occurs on reduplication words, though the words are not reduplications. The following are the examples.

Kupu-kupu	/kupukupu /	/pupupu/ (S1)
		/upuupu/ (S2)

Subject 1 did deletion of two phonemes, not only consonant /k/ but also vowel /u/. S2 only did deletion of the initial consonant phoneme /k/.

Segment Change

Segment change occurs in the initial consonant phonemes of alveolar /r/, /l/, and /s/. Here are examples of the data.

Ria	/ria/	/’wi:a/ (S2)

Lima	/lima/	⇨	/'wima/ (S2)
Suka	/suka/	⇨	/'hu:ka/ (S2)

Phoneme /r/ is replaced by phoneme /w/ because both of them have the same feature, namely the approximant. Additionally, /w/ is selected because it is categorized as semi-vowel. Feature of semi-vowel has similarities with vocal segment; and this segment is more easily articulated and pronounced. The same thing is happened to phoneme /s/ that is replaced by the phoneme /h/. Both also have the same phoneme articulation feature, fricatives.

Mixing

Responses of segment and deletion occur in the following examples.

Teman	/teman/	⇨	/ə'ma:ŋ/	(S2)
Binatang	/binataŋ/	⇨	/'minata/	(S2)
Gajah	/gajah/	⇨	/o:/	(S1)

The word '*teman*' is pronounced by eliminating the initial phoneme /t/ and replace the final phoneme /n/ to /ŋ/. It forms a new pronunciation that much different from the standard pronunciation. The word '*binatang'* is pronounced with the opposite process of articulation, the segment replacement of /b/ into /m/ and followed by deletion of the phoneme /ŋ/. Segment substitution occurs by replacing segments of the same articulation point, which is consonant bilabial and in this context /b/ and /m/ are bilabial. Furthermore, the word 'gajah' show extreme mixing process because all the phonemes in words are removed and replaced with segments /o/.

Impacts of Articulation Responses in Coarticulation of Initial Consonant Phonemes Pronunciation

The responses of deletion and change that are made at the articulation and performed at the pronunciation, affects on the formation of a new pattern called coarticulation. Sound pronunciation articulation process that is not easy is removed or replaced with others that have similar points of articulation and features. The examples are below.

Binatang	/binatang/	⇨	/'minata/
Teman	/teman/	⇨	/ə'ma:ŋ/
Ria	/ria/	⇨	/'wi:a/
Suka	/suka/	⇨	/'hu:ka/

The word *binatang* is coarticulated with /'minata/ because the phoneme /b/ is similar to the phoneme /m/. This is due to the replacement of /b/ by /m/. Phoneme /n/ is coarticulated with /ŋ/ in the word *teman* that is pronounced /ə'ma: ŋ/ by the the subjects. Consonants /n/ and /ŋ/ have the same articulation features, namely nasal. Phoneme /r/ is replaced by /w/ because both consonants has in similarity, approximant. The same happens in the replacement of /s/ with /h/ for the same reason.

Duration

The process of articulation responses subsequently that affects coarticulation also has relationships with duration in the articulation of consonants as phonemes in words. Duration gives the time difference in the process of articulation. From the following examples, it is illustrated that the subject 1 articulates longer than the subject 2 does. This indication raises a presumption that the vocal organs muscle stiffness possessed by the subject 1 is more complex, coupled with hearing loss. Hearing loss reduces ability to process auditory function providing a record of accomplishment cognitively. This process also impacts the process that differentiates the acoustic response of the subject 1 to recite back heard sounds. Description of the duration differences is shown in the following figures.

Figure 1. Subject 1, word *pasar*

Pasar /’a: ə’a:/

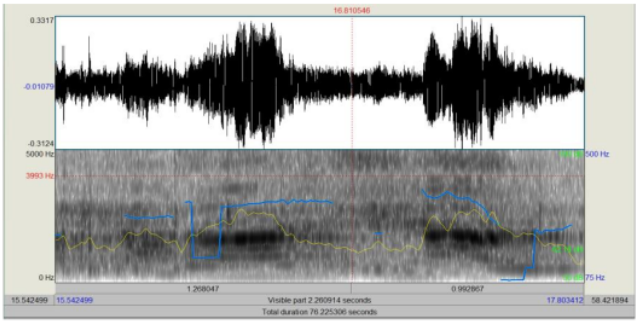
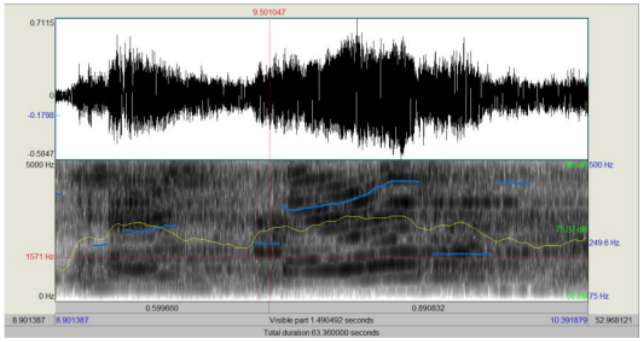


Figure 2. Subject 2 word *pasar*

Pasar /pa’hau/



Subject 1 and subject 2 pronounce the word *pasar*. The articulation process of the word by the subject 1 is approximately 2.26 seconds and by the subject 2 is only 1.49 seconds. This difference occurs because the subject 1 performs removal of noise and replace it with the long vowel /a:/. This replacement is done because allegedly Subject 1 is not able to articulate the consonant phonemes /p/, /s/ and /r/. Subject 2 only performs replacement of two phonemes: /s/ and /r/.

Figure 3. Subject 1, the word *Ragunan*
Ragunan /’a:n’a:h/

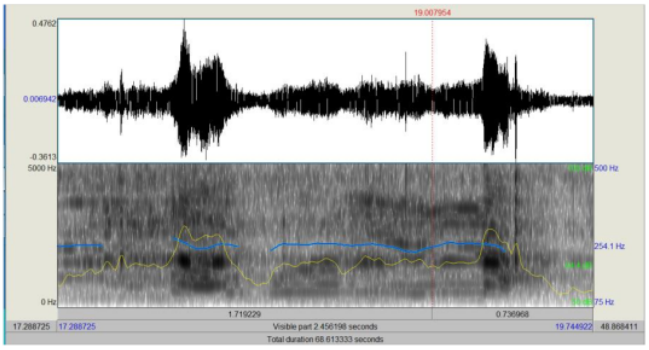
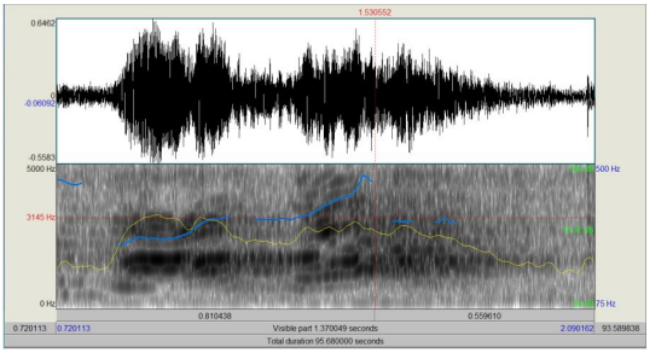


Figure 4. Subject 2, the word *Ragunan*
Ragunan /’a:ŋu’na:/



The same happened in the case of words with three syllables. Similar to the previous words that have two syllables, there are duration differences in the process of articulation of the word *'ragunan'*. The duration needed by S1 is 2.45 seconds and the S2 is 1.37 seconds. There is also a process of replacement and removal of phonemes in words.

The difference results indicate that impaired vision and hearing as an additional impact of cerebral palsy contribute to the inaccuracy of consonants pronunciation. These disorders appear in the footage through analysis of PRAAT software. Different duration appears in the diagram of both subjects when ut[7]r the same words. This is related to the findings of Davis & Co (2006: 1008) which states, *"...the property at issue is consonantal duration. They show that English /s/ in a cluster has a shorter duration than /s/ alone and this correlates with the durational difference between tense [ ] and lax [s] in Korean"*.

Articulation Errors Accommodation Efforts on Students with Athetoid Cerebral Palsy

Articulation disorders that occur in CP students require optimum accommodation. The accommodation must be provided by parents and teachers to overcome the difficulties of individ[1]ls with cerebral palsy to be able to communicate well. According to Pennington (2012: 173) *"To accommodate their child's difficulties and to enable interaction to be completed smoothly and parents may manipulate interaction successfully [1] that their child has opportunities to produce the communication signals that are intelligible." If children are not able to make a target sound (usually a consonant) therapy that includes visual feedback may help them to learn to move their lips and tongue to produce the target sound or an approximation of it"*.

The accommodation is communicatively done to respond the needs of interaction with environment. They need to be accommodated verbally, for example, when they ask for attention, information, clarifications, and expression. The accommodation is provided for the purpose of the communication is by providing information and the time required to respond their stimulation (Pennington, 2012). The most important thing is good communication between parents and teachers for the given consistency accommodation.

CONCLUSION

Varied articulation responses of students with Cerebral Palsy are the impact of nerve paralysis that disrupts muscle function of speech organs. When the function of vocal organs is disturbed, then the articulation of consonants undergo coarticulation. Coarticulation appears in the words, which presents consonants. Coarticulation is by adapting other consonants that have similar point or feature of articulation so articulated words have similar pronunciation. This is an effort of CP students to stay in touch with their environment, despite the fact that they experience many obstacles. These obstacles need to be accommodated by parents and teachers as part of the fulfillment of the needs of the CP students to interact.

SUGGESTIONS

This study has limitations in time of data retrieval so that the data obtained is not optimal. Therefore, the discovery of specific articulation patterns has not been found. In addition, in depth analysis on the problems has not been conducted yet so that the interpretation only covers the surface. Additional data from interviews with parents and related clinical documents will help to provide comprehensive information about a more appropriate way to accommodate CP students linguistically.

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