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Is It Necessary to Modify Science Learning for Autistic Children?

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Abstract: Modifying the curriculum is often necessary for autistic children to effectively engage in learning. Interestingly, a particular learning process proved effective without needing modification, specifically, teaching science to an autistic child. This discovery calls for further investigation. This study aims to comprehensively describe the unique traits exhibited by autistic children who excel in learning science without the need for any modifications. This study utilized the Spradley analysis method, which involves domain analysis, taxonomic analysis, componential analysis, and cultural theme analysis. The participants in this study consisted of elementary school students with autism in the 3rd grade. They were selected using the purposive sampling method. The data collection involved conducting interviews, examining documentation, and studying artefacts. The study's findings indicate that children with mild autism can effectively learn science without requiring adjustments while still receiving necessary accommodations. Tasks can be effectively completed with the support of teachers and the assistance of paraprofessionals. Autistic children demonstrate proficiency in basic science process skills, creativity, and fine motor skills. They also exhibit a positive affect and can socialize effectively. Addressing focus and emotional issues involves implementing structured meal plans, providing parents with guidance on educating their children, and fostering strong collaboration with teachers.

Keywords: autistic children, learning science, elementary school

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Introduction

Law Number 20 of 2003 concerning the National Education System, Article 5, confirms that:1) every citizen has the same right to obtain quality education, 2) citizens who have physical, emotional, mental, intellectual, and social disorders have the right to obtain special education, 3) citizens of remote or underdeveloped areas as well as remote indigenous peoples have the right to receive special service education, and, 4) citizens who have special intelligence and talent potential are entitled to special education. This law is confirmed in Ministerial Regulation Number 70 of 2009, detailing how inclusive education is given to children with special needs. Inclusive education is an education delivery system that provides opportunities for anyone, including children with special needs, to attend education together with other students (Kielblock & Woodcock, 2023; Septiana, 2018).

Students with special needs who have different abilities need adaptations to interact harmoniously with other students in the learning environment. This adaptation is done in two ways, namely, accommodation and modification. Learning this way is called adaptive instruction (Alhassan & Abosi, 2014; Ahmad, 2015). Adaptive instruction is an important element in inclusive education because these special educational goals will be achieved by accommodating students and modifying the methods and curriculum materials used by teachers (Friend & Bursuck, 2015).

One type of special needs found in schools is autistic children. Most autistic children refuse to interact socially with other people, even from an early age. Autistic children often avoid eye contact with other people and are not interested in connecting socially with other people (Demopoulos et al., 2013). An autistic child is sometimes isolated in communication practices because he cannot see a

communication theme from another person's point of view and does not know how to interact in the form of give and take.

Students with autism find difficulties in social interaction because of difficulties in using and responding to verbal and non-verbal communication (Matson et al., 2013). Autistic students often experience delays in language development, and even though they have language skills, they have difficulty communicating with others. Autistic students often do not have the words to express their ideas. Therefore, they replaced it with screams. Students who cannot write change their way of communicating by using behaviour to express their wishes or thoughts. Students with autism spectrum disorders like to repeat other people's words rather than respond to forms of communication addressed to them (Friend & Bursuck, 2015).

Another feature of students with autism spectrum disorders is their limited range of interests (Parmeggiani et al., 2019). A small range of interests means that an autistic student who tends to be interested in something will spend his time on that thing and ignore other things. They will easily get bored with conversations whose topics do not suit their interests. As a result, children with autism spectrum disorder may not understand that other people do not have the same interests (Friend & Bursuck, 2015). Autistic students experience stress easily and, at the same time, have difficulty dealing with the stress that befalls them and then respond in the form (Maskey et al., 2013; Trembath et al., 2012). Autistic students will find it difficult to change school benches' arrangement from usual, new routes from one place to another and have difficulty doing something that involves certain steps.

Like other students studying in elementary schools, autistic children also have the right to receive natural science lessons. Natural Science is a scientific discipline that aims to seek explanations about nature. Natural Science consists of two components, namely 1) Systematic activity to seek explanations about natural phenomena, both objects and events and 2) A collection of dynamic knowledge resulting from systematic activity to seek explanations for natural objects and events through science process skills (DeRosa & Abruscato, 2018; Jevons, 2022).

Inclusive science learning is carried out in inclusive schools. This learning means learning intended for all students without exception, both normal students and students with special needs. Children with special needs have special characteristics that lead to special treatment. This treatment is a form of harmonization of learning for students with special needs and normal students. For special treatment to create harmonization, it is necessary to understand the characteristics of children with special needs so that teachers can choose the right method to serve according to these characteristics without leaving normal students. This form of adjustment is known as accommodation and modification in learning.

A study has shown that different teaching strategies are used in inclusive schools to accommodate all students, adding study time, individual work, and group work, and adapting learning activities to students' cognitive characteristics. These findings have shown the best learning practices for children with special needs. In addition, these findings have also shown evidence of the suitability of learning that pays attention to one's right to education by adapting the curriculum to meet all students' needs. Learning activities must be flexible and can be adapted to environmental conditions because of changes that continue to occur (Adewumi et al., 2017).

Students with autism spectrum disorder often display unusual behaviour and can make teachers and peers who don't understand them nervous. Such behaviours can become a barrier to learning activities. However, this behaviour can be changed through a structured 'behaviour assistance' program (Koegel et al., 2012). Some behaviours can be resolved using simple workarounds, while others can be ignored. For example, if an autistic student starts to withdraw from learning activities in class and starts swinging his body every day at around 11.00, it could be a sign that he is too hungry to do activities until lunchtime at 11.45. Therefore, the teacher can give the student a snack in the corner of the classroom to reduce the feeling of hunger experienced. By providing recognition of student needs and handling them with appropriate interventions, autistic students will be able to accept some or all of the learning activities in public classrooms (Hart, 2012)

For children with autism, a positive learning environment is needed. Therefore, teachers must establish clear classroom assignment procedures and routines and then apply them consistently. In addition to structure, autistic students also need the opportunity in a day to work alone and to be left alone. This time serves as a break from the visual and audio pressures and the social and communication demands that arise in the classroom (Friend & Bursuck, 2015).

One way to create a positive learning environment is to use the concept of a garden as a therapy zone. Children with autism who have sensory system disorders fail to respond and are not adaptive to the environment, so gardens are needed, which have potential as a means of therapy and education. As a therapeutic tool, garden space organization provides a stimulus for visual, auditory, tactile, olfactory, and taste aspects. The park is a physical, creative, and social play area for education. Utilization of open space can help student development through sensory stimulation (Martana & Hafilda, 2021).

Apart from the environment, methods and media also have a role in learning with autistic children. The discussion method combined with three-dimensional media is one of the appropriate learning methods for autistic children. The discussion method is carried out so that students' attention is focused on the learning material. One media that can be combined with the discussion method is the torso. Torso media will attract the attention of students with autism and foster student interest (Susanto & Pamuji, 2014). Apart from the torso, dioramas are also appropriate for learning with autistic children. Using diorama media is adapted to the conditions of inclusion children using prompts. The prompt is guidance so autistic children can respond to external stimuli correctly. Researchers give prompts to students in all conditions. The prompt can be verbal or non-verbal (Iswandari, 2017). Another media that supports the learning activities of autistic children is illustrated stories. Illustrated stories are proven to be able to attract the attention of autistic students to learn so that their cognitive abilities increase (Utami et al., 2017)

Ichsan & Iswari (2019) found that learning science for autistic children, as a type of special needs, requires curriculum modification. The teacher prepares media that is adjusted to the learning objectives, the learning process is adjusted to the child's abilities, and the arrangement of seats is managed so that children can communicate with their friends easily. Knight et al. (2020) found that learning science for children with autism requires texts that are adapted according to the child's abilities. Apart from the adapted material, the tasks for children with autism also underwent modifications, as Tzanakaki et al. (2014) found. The study's results by Carnahan et al. (2016) explained that children with autism need help using highlights for important vocabulary reading. Besides that, they need to be given repetitions as a summary of the text read. A science lesson that has been researched by Jimenez et al. (2014) shows that science material will be well received, in addition to using scientific investigations, through storytelling activities or science stories. Autistic students can be activated using examples, non-examples, and cooperative learning and even taught to relate the findings to the concepts they already have. Meanwhile, Rockwell et al. (2011) found that mnemonic strategies can help autistic children solve problems.

Science lessons for autistic children are also held in inclusive schools in Indonesia, including Giwangan Elementary School. A grand tour was carried out by interviewing one of the class teachers. The class used in this context is class III, which has an autistic student. Based on the interviews, information was obtained that the learning was not modified because children with autism could participate in learning. This is an interesting finding to be explored further, bearing in mind that, in general, children with special needs are students who need special needs, as supported by Ichsan & Iswari (2019), Koegel et al. (2012), and Martana & Hafilda (2021). Based on these findings, the research is to reveal how autistic children learn science so that no modification is needed. This disclosure is significant as earlier research investigations have shown that the majority of autistic children need adjustment.

Methods

This research used a qualitative approach with a case study type. This research was conducted at Giwangan Elementary School in August-October 2022. Subject selection was carried out through purposive sampling. The subject of this study was class III teachers at Giwangan Elementary School who have autistic students, parents of autistic students, and autistic students (initial L). Data was collected using observation, unstructured interviews, and analyzing artefacts such as comics, designs, key chains, and intricate buildings. The instruments used were observation guidelines and interview guidelines. Data were analyzed using Spradley techniques such as domain analysis, taxonomic analysis, componential analysis, and analysis of cultural themes. Data validity was carried out through triangulation, member checks and peer debriefing.

Results and Discussion

Result

L's disability condition has been known since the age of 1.5 years. At that time, L's parents found L unsurprised when there was thunder. As if not heard. Even so, when parents showed videos on their laptops via the YouTube page, L liked them. When L watches the show in the form of a film, he can give expressions as the topic is presented in the film. For example, if the film shows a funny topic, then L will laugh.

L then underwent a hearing test and went to a neurologist. The neurologist sentenced that there was damage to the left side of the brain or stroke in children. Through the assessment process, L was sentenced to have ADD, then ADHD, and lastly was sentenced to have autism.

At the age of 2 years, L was known to have a speech delay. It is presumably because L did not go through the process of crawling. Apart from speech, L has emotional problems. The therapy process was found to be able to reduce ADHD (Attention Deficit Hyperactivity Disorder) to ADD (Attention Deficit Disorder).

L entered Giwangan Elementary School in grade 1 and used independent paraprofessionals. The learning process is mostly done outside the classroom because L can still not focus on paying attention to the teacher. At that time, L could not communicate in two directions and could only imitate. L's interest is in nature. Therefore, his teacher often invites him to see the surrounding environment, especially plant species, while memorizing their names. Outside the classroom, L was accompanied by paraprofessionals.

When he first entered, L couldn't talk much and only imitated the words addressed to him. For example, when asked, "What's your name?" L imitated, "What's your name?". Such children, said L's parents, tend to feel afraid and, when approached, feel intimidated. At least, there were 2 to 3 vocabularies that L had just mastered when he entered grade 1. Therefore, L's parents taught vocabulary in everyday life by observing all objects, saying their names, and then repeating them to L.

After 6 months, L was able to read on his own. After he was able to read and his vocabulary increased, L spoke more fluently. Even so, L struggled to understand the adjective because the form didn't exist. For example, L can easily recognize "bottle" but not "stupid" because the bottle is visible while the dope is not. When learning to read, unfamiliar and unknown letter arrangements are always asked. The books he likes to read are general comics and science comics.

L's emotional development is also improving because it is supported by good intake. Since the age of 3 years, L has not consumed gluten-containing foods, including flour and its derivatives, milk, and its derivatives, avoiding sugar and caffeine. Since birth, L was seen to have a posture that was not like other children. His eyes were narrow, his neck was short, and his hair was red. The red hair is strongly suspected due to the accumulation of heavy metals. The diet that was carried out succeeded in turning L's hair black. The diet affects the body's metabolism. When there are a lot of calories, there is a lot of energy, which makes L unable to focus due to excess energy. As a result, L was unable to understand the lesson properly.

In addition to diet, focus exercises are carried out by facing the parents' faces. Parents are accustomed to L making eye contact with the other person. Slowly, starting with eye contact for one second, L's focus improved. When eye contact occurs, L will know what the conversation is about.

At the age of kindergarten, L already knew the shapes of letters, both Latin and Arabic. In grade 1, L started to be able to make comics. At that time, L imitated what the characters in the comic said. If he doesn't know the vocabulary in the comic, L will ask his parents. Focus and calm while participating in class learning are also supported by the diet that is carried out.

By the time of grade 3, L's social ability had improved. The class teacher arranged the classroom benches so that L could socialize better. Although L's answers were brief, the teacher also motivated classmates to communicate with L.

L needs full assistance during learning. For example, his paraprofessionals come forward when submitting work. L has started to be independent in just a few weeks, including conveying ideas and leading classmates in prayer. L has the rule-abiding type. Therefore, when something doesn't go according to schedule, L will protest. For example, if something was left behind, while L saw his friends carrying things that should have been taken, L's emotions peaked, and he blamed himself. When emotions run high, L doesn't hurt others but hurts himself, for example, by hitting his head.

L has the motivation to achieve achievements like other friends. It's just that L could not understand the material that was only conveyed through lectures. The same thing can happen to his classmates. L better captures the subject matter when using props, media, etc. L can accept material presented in lectures with repetitions. Because the teacher cannot always focus on L during learning, the role of paraprofessionals is important to repeat the material the class teacher delivers. L will quickly understand the material if he likes it, for example, natural science material and free drawing. In addition, L will be more active in the subjects he likes. For example, he wants to share his experiences with his plants at home without being asked by the teacher.

At the beginning of grade 3, L began to be able to solve questions that used certain processing procedures (Fig. 1). L also constructed a play construct resembling the Goldberg rube (Fig. 2). At that time, L produced many works, including crossing plants at home.

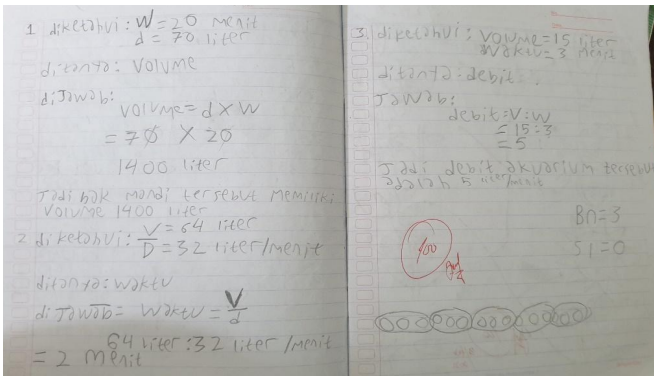


Figure 1. The Results of L's Work to Calculate the Debit of Water

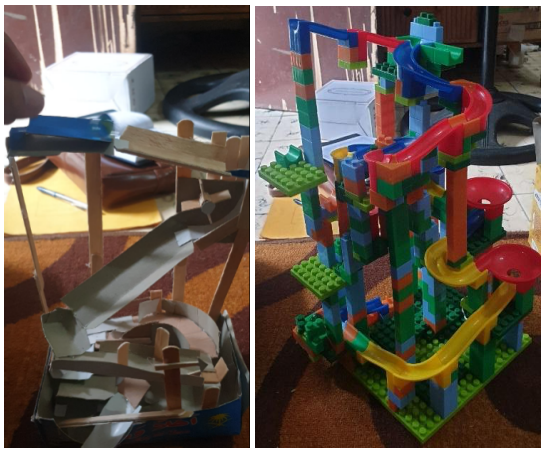
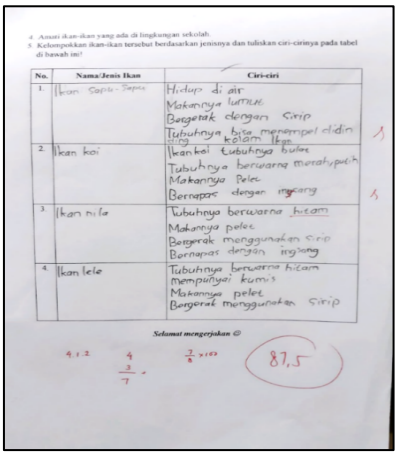


Figure 2. A Series of Intricate Buildings Resembling the Rube Goldberg Idea Made By L

In grade 5 of elementary school, L could explore independently by using keywords obtained from the school, such as "energy saving". Through these keywords, L found out about biogas and electric cars. The curiosity that is owned makes their teachers avoid L so as not to become the target of creative questions from L.

During cooperative learning group, L participated in working in groups on the parts he was able to, for example, making observations, counting, carrying objects, arranging and other simple jobs (Fig. 3). As for leading the group, L has not been able to, including when asked to explain the contents of the worksheet as a whole.



No.	Nama/Jenis Ikan	Ciri-ciri
1.	Ikan Sapu-Sapu	Hidup di air Makanya lumut Bergerak dengan Sirip Tubuhnya bisa menempel didinding kaca dalam ikan
2.	Ikan koi	Ikan hal tubuhnya bulat Tubuhnya berwarna merah putih Makannya Pelet Bernapas dengan insang
3.	Ikan nila	Tubuhnya berwarna hitam Makanya pelet Bergerak menggunakan sirip Bernapas dengan insang
4.	Ikan lele	Tubuhnya berwarna hitam mempunyai kumis Makannya pelet Bergerak menggunakan sirip

Selamat mengerjakan ©

Figure 3. L Participates in Investigating the Characteristics of Fish through Observation and the Results of L's Work in Groups.

L can make observations on various objects and events, for example, the types of leaves and the process of melting butter, and communicate the results of observations, including being able to paraphrase texts into comics with conversations from their imagination but with the same theme as the original text. L can create comics based on his imagination (Fig. 4).

Figure 4. An Example of a Comic Created by L

L can also classify based on the character of the objects that appear while arranging these objects neatly simultaneously. L's teacher said, "*L can put the leaves according to the shape of the leaves*." L able to take measurements using standard and non-standard units. About experimental activities, L was able to explain that objects melt due to heating and answer what happens to an object if it experiences certain events.

L has responsibility for schoolwork and homework. L always records the material given and remembers homework to do at home. If it is incomplete, the teacher will take a photo, and L will continue the notes at home (Fig. 5).

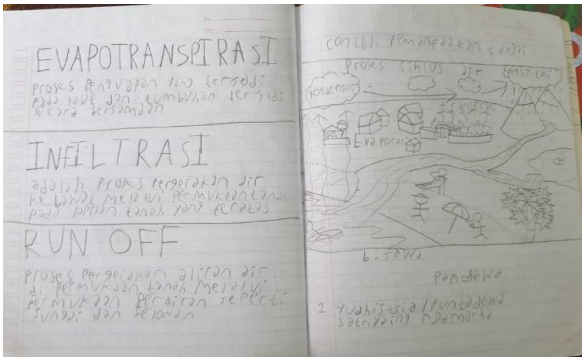


Figure 5. L's Notes Explaining Natural Events Related to Water and the Water Cycle

The role of parents in the development of L is very significant. L's parents always accompany and facilitate L's learning activities. L's parents taught knowledge through direct observation of the objects being studied. Parents also teach events and cause-and-effect relationships.

Discussion

Initially, L was diagnosed with ADHD (attention deficit hyperactivity disorder). After going through a period of therapy, the "H" element or hyperactivity disappears so that it becomes ADD (Attention Deficit Disorder). The last diagnosis was that L was declared to have autism and experienced speech and emotional disturbances. L also still had difficulty socializing at the beginning of school and found it difficult to make eye contact. This feature is also mentioned by Demopoulos et al. (2013), Bhat (2021), and Yanti et al. (2022) for autistic children. Primasari & Supena (2020) also stated that one of the characteristics of autistic children is experiencing speech disorders. L was found only to be able to imitate the speech of the person who taught him to speak, as found by Masnur (2016)

L's parents dealt with L's condition by providing good assistance. One of the roles shown by L's parents is to take part in training related to handling children with autism. The role of good parents is very important, as stated by Pardede & Febrianti (2019). Apart from parents, the role of teachers at school, both class teachers and paraprofessionals, also contributed to L's development. It was shown when L was accompanied by paraprofessionals while studying in nature (Walker et al., 2021).

L's emotional development is also supported by a diet that avoids gluten, flour, sugar and caffeine. L is calmer when the calories are not excessive because there is no excess energy. Doreswamy et al. (2020) found something similar: reducing gluten and carbohydrates will provide quality sleep, improve communication skills, reduce tantrums, and stabilize emotions. Another effect that L's parents felt was increased eye contact and focus. When eye contact occurs, communication is established better.

The concept map in Figure 6 shows the results of data analysis showing L's background before learning natural science activities in grade 3.

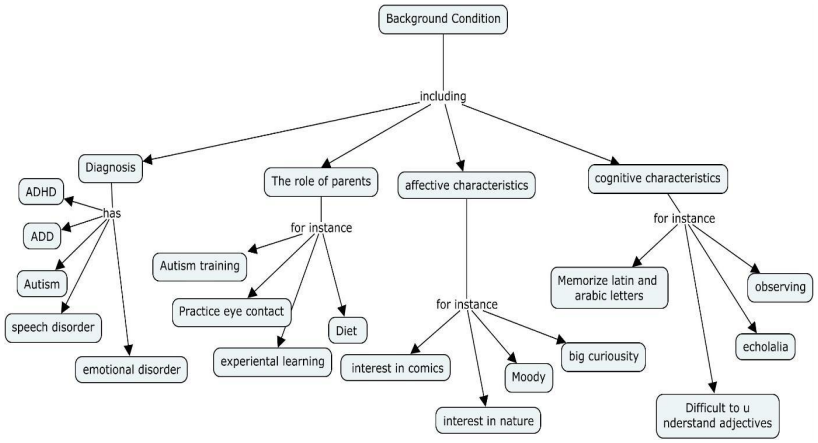


Figure 6. Concept Map of L Condition Background

When L reached grade 3, his socialization skills greatly improved. The teacher positioned the seat L for better socializing. In addition, the teacher encourages classmates to start communicating with L. The effort made by the teacher is part of the accommodation in the learning process (Friend & Bursuck, 2015). Even so, there is an appearance of characteristics of an autistic child with uncontrolled emotions and self-harm (Demopoulos et al., 2013). The development of L as an autistic child through certain interventions was also found by Muqoddam & Hendriani (2019), who argued that interventions could be given to autistic children so that their ability to interact with others was better, even for adults. In their study, Alexander & Padavan (2021) found that lack of intervention by parents makes children with autism less skilled in socializing. In addition, according to research findings, variations in seating positions will make L's interactions more varied, and this process will improve his social skills.

L is already motivated to achieve achievements and learning outcomes like his classmates. Even so, L tends to understand the material if it is conveyed through the help of props and media. Susanto & Pamuji (2014), Iswandari (2017), and Utami et al. (2017) found that the use of media can affect the learning outcomes of autistic children. In addition, Cipta et al. (2019) stated in their study that learning

for autistic children is greatly assisted by using communication board media, which contain illustrated information and brief explanations of the material being studied. Not only print media but also electronic-based media can help autistic children learn, as found by Khadafi et al. (2022), who developed multimedia to introduce letters to autistic children.

L also easily accepts material and is active in learning if he likes it, for example, material about the natural surroundings. This preference made L explore the subject matter he had just received at home via the Internet. Focusing on a preference and ignoring other things becomes a character that is in line with the opinion of Friend & Bursuck (2015)

L has good fine motor skills. It does not correspond to the characteristics of some autistic children who have motor disorders (Bektiningsih, 2009; Iskandar, 2019). A study by Nordin et al. (2021) also found that children with autism tend to have developmental barriers in gross and fine motor development compared to children with normal development. L also has good creativity. It is supported by findings from previous research, which found a strong correlation between creativity and autism (Best et al., 2015).

L can follow the abilities of his classmates in counting, organizing objects, and doing simple work in groups. In addition, L can make observations, communicate data, interpret, classify, measure, infer and predict. These abilities can indeed be possessed by autistic children, as mentioned by Settlage & Southerland (2012). These activities are science process skills. The ability of autistic children to follow science lessons well because they have very good memories was found by Ediyanto & Fatmawati (2020). Memory is important in performing science process skills because it is the most basic thinking skill. Although Ediyanto & Fatmawati (2020) also stated that no findings indicate that autistic students can perform science process skills, findings in the field show otherwise. L can classify leaf shapes and place them in their respective groups. In addition, L also understands the logic of cause and effect by inferring the effects of heating on the shape of an object. L's schoolwork is completed with full responsibility. L's rapid development involves a large role of parents, especially in establishing communication with teachers, as Laurent & Gorman (2018) argued.

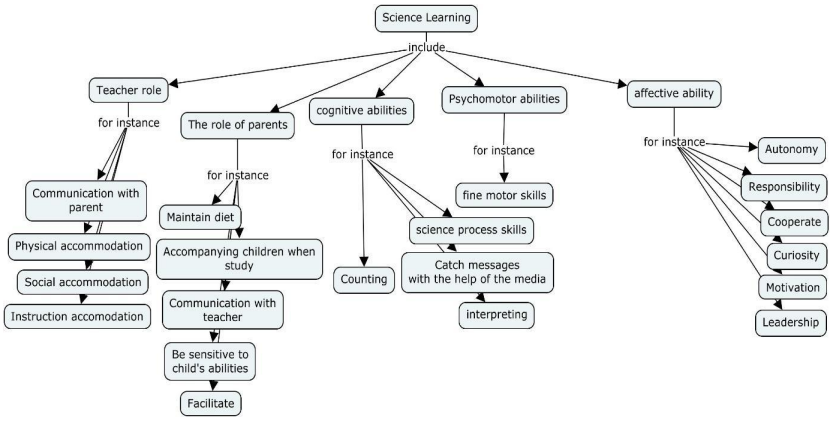


Figure 7. Concept Map of the Science Learning Process Experienced by L

Conclusion

Based on the discussion, it can be concluded that L does not require modifications in science learning and can participate in science learning with other friends who do not have special needs. L can perform science process skills, use numbers, understand messages through the media and interpret messages. In addition, L has good fine motor skills. L also has a sense of responsibility, willingness to cooperate, curiosity, motivation, and ability to lead. The role of parents who are very good in providing good nutrition, accompanying time in learning, and patience are contributing factors to L's development. In addition, class teachers and accompanying teachers also make a major contribution to the development of L's abilities.

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