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Counterproductive Gesture: The Thinking Process of Slow Learners in Solving Integer Operations Problems

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Abstract

Introduction: The learning process carried out by slow learners at special schools garners substantial attention. Gestures that are produced spontaneously by them possibly represent students' thoughts.

Objectives: The purpose of this research is to describe the thinking processes of slow learners when solving integer addition and subtraction problems through their gestures.

Methods: A qualitative method with case study research was adopted in this study. The subject of this study was a slow learner student at a Special School in East Java, Indonesia. The student was chosen because he was indicated to produce counterproductive gestures while solving math problems. Counterproductive gestures are gestures from the teacher (source) that are processed inappropriately by the recipient. This phenomenon requires a more comprehensive investigation, particularly for slow learners, to gain deeper insights into their problem-solving cognitive processes influenced by counterproductive gestures.

Results: The results of the study showed that slow learner students often saw the movement of the teacher's lips (source) compared to the movements of other body parts (fingers, arms, and hands). As a result, slow learner students do not understand the meaning conveyed through other body movements (fingers, arms, and hands).

Conclusions: Students have difficulty making abstractions on the concept of adding and subtracting integers, causing students to easily experience distraction from actions carried out in the form of gestures. As a result, there is a mismatch of gestures when solving addition and subtraction problems.

Keywords: thinking process, gesture, counterproductive gestures, slow learner students, mathematics problem

1. Introduction

Slow learner (SL) students are those who are slow in the learning process, requiring more time than their peers with equivalent intellectual potential. However, they are not classified as mentally retarded children. Their IQ test scores range between 76 – 89 (Chauhan, 2011). Difficulties in the process of receiving information experienced by SL students frequently pose issues in their education as they face difficulty in focusing or concentrating. In addition, Lowry (1972) asserted that SL students were slow in learning mathematics. Linearly, Herriot & Sarah (1967) described SL students as having no ability to understand mathematics and being weak in manipulating computational algorithms.

For most of the action research, SL students are often perceived as disturbing, although they are constantly presence in every class. Therefore, SL students are also required to be able to understand the materials presented by the teacher in class. Besides, mathematics learning is essential for SL students because the National Council of Teachers of Mathematics (NCTM) recommends that all students learn mathematics, including students with special needs. Tursunai et al., (2020) also specified that the world research institutions are slowly starting to examine the fulfillment of students' equal rights. Further, it encourages the formulation of a methodology that focuses on mathematics and awareness of the important role numeracy plays in society. Sa'dijah et al. (2016) described learning mathematics in schools can serve as the catalyst for students' creative thinking skills to solve mathematical problems and make choices. In addition, Susilawati et al., (2023) expounded that in special schools, the success of inclusive education is classified when students with special needs depend heavily on the presence of a culture of inclusion, therefore, it is necessary to study and improve education for children with special needs. It is imperative that all students be provided with the necessary opportunities and support to study mathematics deeply, attaining maximum understanding (NCTM, 2000). Therefore, SL students are also required to acquire higher thinking skills level to facilitate the transfer of knowledge, thinking critically, and solving problems (Sofyan, 2019). Research conducted by Chauhan (2011) revealed that SL students have cognitive limitations and difficulties in conveying ideas both orally and in writing. Besides, their ability to deal with abstract and symbolic material is very limited, and their reasoning in practical situations is lower than that of the average student.

Based on theoretical studies related to the characteristics of SL students, in our preliminary study, observations were carried out by participating in a learning involving SL students. Through these observations, SL students translated information into concrete form. They also presented difficulty in focusing on one point, so the teacher must make more effort to attract students' attention. These efforts were made both with concrete objects and gestures, aiding SL students to be more interested in learning. Therefore, the actions and engagement of slow learner students, specifically in learning mathematics, represent a significant component contributing to their mathematic comprehension and mathematical problem resolution. Their action is one form of gesture.

Becvar et al. (2008) defined gesture as the expression of all members of the body that is integrated with speech or action to communicate a message. Meanwhile, Novack & Goldin-Meadow (2017) defined that gesture occurs on objects in the air. However, gesture and movement are different. Gesture, as defined, constitutes a representational motion characterized by movements without direct object contact and simultaneous occurrence with speech. These external bodily representations, encompassing movement, are integral to the cognitive system, facilitating the exchange of ideas among learners pursuing a common objective. Recent research conducted by Wakefield et al. (2021); Congdon et al. (2017); Yeo et al. (2017); Beege et al. (2020) positioned the simultaneity of speech and gestures as an important aspect when children receive instructions from a teacher. The concurrent of speech and gestures is also practiced by teachers in special schools. Specifically, investigating whether the instructions delivered by teachers hold equal significance for slow learner students represents a noteworthy area for in-depth research.

Gestures are used either separately or simultaneously with speech. Gestures are made when providing assistance or special educational learning strategies to help students with disabilities in learning mathematics. Thus, gestures are useful for students with learning disabilities (LD), specifically when they develop an understanding of a new concept and when working memory is subjected to a problem-solving task or information processing and stored (Walsh & Hord, 2019; Hord et al., 2016). For students with special needs, gesture serves as a tool or strategy that supports them in learning mathematics. In research conducted by Walsh & Hord (2019), teachers are reported to use gestures and diagrams to support their students with learning disabilities, specifically to regulate students' thinking processes and understand the relationships between problem elements. In addition, gestures, especially pointing gestures, are commonly adopted to provide explanations to students regarding mathematical concepts or ideas in exchange for the structure of mathematics learning (Ruhama et al., 2018).

Gesture carry an essential role in solving math problems for SL students. It is used as a means for expressing mathematical ideas. Zurina & Williams (2011) have performed research focusing on gestures not necessarily intended for external communication but rather as internalized expressions containing utterances made in one's mind and actions performed. Besides, our preliminary observations at Special School, suggested that when slow learner students are given the problem of adding and subtracting integers, they present gestures aimed at themselves as their visual representation. These gestures are acquired during the learning. Furthermore, the types of gestures employed by teachers during the teaching process align with classifications put forth by Alibali & Nathan (2012), consisting of pointing and representational gestures. Pointing gestures are used to show pictures, locations, people, or objects. This representational gesture is classified as an iconic gesture and a metaphoric gesture. The representational gesture is a movement that represents the content of speech, either by pointing to a reference in the physical environment (deictic), by imitating hand movements or shapes (iconic), or by making physical references to abstract ideas (metaphoric) (Hostetter & Alibali, 2008). In detail, Gunawan et al. (2021) described the usage of several gestures, such as the gestures of pointing to assist students in deciphering plans for completing answers, helping to focus themselves on doing calculations, generating ideas, and facilitating the description of information from debriefing, checking and understanding questions and solving questions. Meanwhile, representational gestures help students describe the steps for understanding graphs related to problems, focus on understanding problems, and solve problems carefully. Further, it serves to concretize and clarify the ideas or concepts that students are actively working on or contemplating.

Gestures performed by the teacher (source) are significant for slow learner students, offering valuable insights that they can apply in future problem-solving. Alibali & Nathan (2012) stated that when teachers teach about concepts, they routinely produce gestures with speech. Likewise, when students communicate the concepts they have learned, they initially express their new knowledge in the form of gestures. Students' gestures are adopted from gestures practiced by the teacher in the learning process. However, during the preliminary research, certain irregularities emerged when solving addition and subtraction of integers. Slow learner students experience gesture discrepancies during the learning process as well as when they are solving the addition and subtraction of integers. This gesture discrepancy refers to counterproductive gestures. These counterproductive gestures represent instances where gestures provided by the teacher (the source) to explain mathematical concepts are inadequately processed or misinterpreted by the gestures of slow learners (the gesture recipients).

As a consequence, gestures for SL students should be designed with careful consideration of the unique characteristics of these individuals. Without such specially designed gestures, there exist discrepancies in gestures that manifest during the on going learning process, which require special attention. As described by Alibali & Nathan (2012), gestures serve as evidence that the body is involved in thinking and communicating ideas. Theories of Embodied Cognition expressed by Pier et al. (2019) explain that cognitive abilities are related to an individual's actions and perceptual systems. According to this theoretical framework, students process and comprehend ideas through their bodily experiences and senses, with the body playing a central role in shaping cognition (Wilson, 2002). The gestures of SL students in solving math problems are very important to explore, as they offer valuable insights into their cognitive processes and the expression of mathematical ideas. Slow learner students often exhibit challenges in communication (Shaw, 2010).

In addition, various types of gestures have been described by McNeill (1992), including iconic gestures, metaphoric gestures, and deictic gestures. In this study, the iconic and metaphoric gestures will be referred to as representational gestures (Alibali & Nathan, 2012). These two gestures, in particular, facilitate understanding of the cognitive processes of slow learner students, as they involve the recognition of movements concomitant with their facial expressions. Deictic gestures are made by pointing since they are defined as gestures used to point at pictures, locations, people, or objects. Meanwhile, representational gestures explain the relationship between a physical form and the hand movements that are performed, such as describing the length or dimensions of an object.

Several studies have specifically examined gestures in children with special needs Cermak et al. (1980); David McNeill (1985); Healy (2012); Hord et al. (2016); Hord et al. (2021) and Walsh & Hord (2019). Those studies mainly (1) explore the role of the sensory experience in the learning process (2) explore the role of gestures in students with special needs in language development, (3) affirm that a movement system integrated with speech is a strong feature for learning and (4) explore the role of gestures and diagrams in solving math problems. From the available research, there have been no studies examining the correlation between gesture and cognitive processes among students with special needs. Thus, this research explores the slow learner students' thinking and gestures during the process of solving problems of integer operations, particularly through their hand movements and expressions. The focus of this study encompasses gestures directed both toward others and oneself, whether they are accompanied by speech or not, with the aim of elucidating the thought processes within slow learner students. Consequently, the central inquiry within this study centres on deciphering the cognitive underpinnings of slow learners, particularly with regard to their counterproductive gestures.

2. Methods

Research Design

This research adopted a qualitative method with a case study design. A case study is defined as a process of in-depth, detailed investigation or examination of a particular or special event. For the research participant, this study involved three slow-learner students from the fourth grade of a Special School. During the data collection, we followed learning activities on the topic of integer operations, with the teacher practicing many gestures while explaining concepts and giving examples of questions to slow learner students. Further, students also used gestures as the teacher did during the teaching and learning process. The three slow learner students presented the three gestures previously classified by Alibali & Nathan, (2012), namely, deictic, representational, and writing gestures. Furthermore, the three slow-learner students were given an integer operation task sheet. Besides the video recording of the participants solving the problem, all slow learner students practiced gestures. However, the research investigation unearthed a distinctive characteristic in one particular slow learner student's approach to solving integer addition and subtraction problems, coded as LM. LM was chosen as the research subject due to its distinctive utilization of gestures during these mathematical operations. The difference from LM was in the prevalence of counterproductive gestures during the problem-solving process. Counterproductive gestures, as previously defined, represent the gestures initially provided by the teacher (the source) but subsequently processed in an inappropriate manner by the recipient. The involvement of this one student was sufficient for exploring the counterproductive gesture during problem-solving, representing their thought process. Sources of data in this study are primary data and secondary data. Primary data were collected from video recordings of LM in solving problems. Furthermore, secondary data originated from important documents related to the category of slow learner students' mathematical thinking processes, such as their work, learning video recordings, coding.

Data Collection Tools

In this study, we collected both primary and secondary data. Primary data were from video recordings of SL students solving integer operations problems. Meanwhile, the secondary data were collected from important documents related to the categories of students' mathematical thinking processes, including their work, video recordings, as well as the coding and structural diagrams of students' mathematical thinking processes. During the data collection process, the researchers were performed as the central instrument as we collected the data in the form of notes from the direct observations. To strengthen the research data, a number of supporting tools were used, including (1) an audio-visual camera to record all learning activities of slow learner students along with their gestures and (2) individual task sheets on addition and subtraction of integers.

Data Collection and Analysis

The primary data were from a recording of SL students' activity while solving integer operations problems. The students' activities were carefully observed, focusing on the diverse range of gestures they employed to discern their cognitive processes. The collected data correlates with the categories of students' thinking processes in the form of video recordings, coding of thinking processes, and structural diagrams of students' thinking processes. The validity of the garnered data was assessed using data triangulation by comparing the data from the video recording with the student assignment sheet data.

3. Results

The garnered data were analysed, including the descriptions and diagrams of SL students' thinking structure when learning the concept of addition and subtraction of integers. The analysis was conducted on the learning involving the teacher and students' process of adding and subtracting integers. Description analysis is arranged systematically with the following procedures:

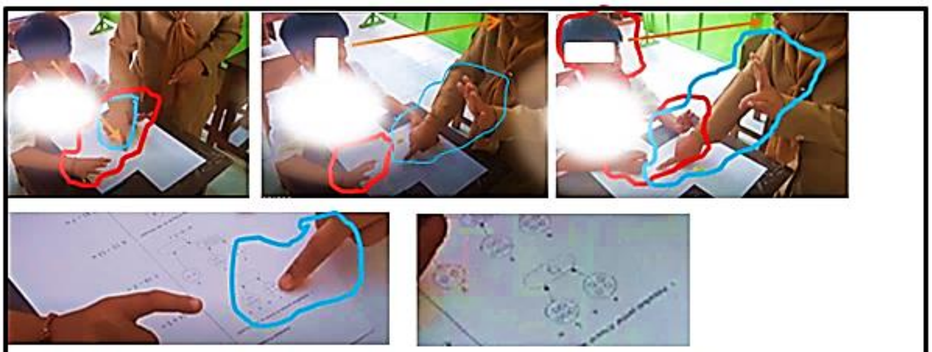
1. Chose a collage of video footage for the analysis;

2. Compile transcripts of conversations between the teacher and participants based on the cut out points (1);

3. Analyse the conversation transcripts that indicate the process of narrative thinking arises from points (1) and (2);
4. Construct a thinking structure diagram based on points (3).

When selecting a collage of video footage, we adopted colour squiggle lines, with each of them signifying a specific meaning. A straight line with orange arrowheads indicates slow learners' focused attention to the teacher's words and questions. The green line suggests the teacher's attentive engagement with SL students. Meanwhile, the blue line indicates instances in which the teacher uses gestures to explain the problems faced by SL students, either accompanied by spoken communication or others. The red line represents the gesture practiced by SL students, encompassing hand movements or facial expressions.

At the beginning of the learning process, the teacher instructed students to count the balls by pointing to objects (circles) within a designated circle. This initial process serves as the first step to engage the SL students in the task. Then, the teacher asks the SL students to add up the objects (ball-shaped) through their guidance. Furthermore, the student's process of solving a problem is described, and their thinking processes are analysed from students' body movements through audio-visual recordings. This series of analyses was carried out specifically on a student coded as LM due to LM's observed issues in adding and subtracting integer operations independently. Even though LM has presented sufficient attentiveness during the lesson (problem-solving assistance) on integer addition operations. Therefore, it is essential to explore LM's thinking process in solving integer addition and subtraction operations.

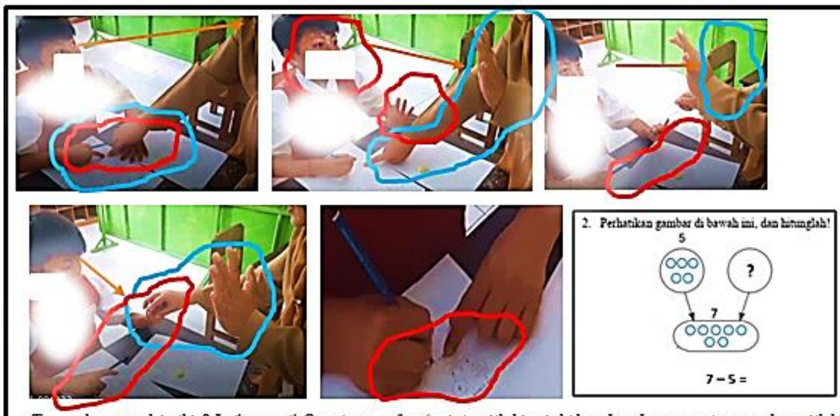


T : Look, how many are there? (points and makes an icon with his finger) how much?
LM : four...four (in a very low voice)
T : *plus (makes the addition symbol with his finger) five (makes the five symbol with his finger), how many? 4 plus 5 (makes the number symbols 4 and 5) how many are counted (the teacher points to the picture)!*
LM iconizes a number with his finger (trying to count) (there is a movement that does not match the one given by T).
T : *add up, you know... plus (the teacher makes a number icon with his finger).*
LM observes the teacher and imitates what the teacher does (at 00.50-01.19 minutes)
T : *look (points to the question) count how many there are in all, four, five, six, seven, eight, nine, write..nine (points to the object in the question)!*
LM imitated the teacher's lip movements and moved his hands as the teacher did. Then write down the answers
T : *yes good (pointing his thumb).*
T : *right now ...how much is this? Four (moving his hand) plus five plus two (moving his finger to form a two symbol), how much?*
LM pays attention to the teacher by looking at the teacher and the symbols he does with his finger and tries to imitate the sound the teacher makes.
T : *(teacher points to the object in question by counting and concretizing it by making symbols on her finger) one, two, three, four, five, six, seven, eight, nine, ten, eleven.*
LM pay attention to the movement of the teacher's lips without paying attention to what the teacher is pointing at.

Figure 1. Interaction 1 in learning the addition of integers

Figure 1 illustrates the interaction between LM and the teacher in understanding the problem and identifying integer operations, specifically the "addition." Identification of the addition problem is facilitated by a set of balls and concrete objects. This process begins when the teacher asks LM the quantity of balls present. LM seemed unable to answer without the teacher's help. Then, the teacher tries to point to the ball by using his right and left hands to represent the number of balls he mentioned. Interestingly, LM's eyes were seen observing the teacher's lip movements instead of the teacher's hand movements on the worksheet. Besides, LM also responds to the teacher's actions using gestures with the fingers of his right hand to symbolize the numerical values spoken by the teacher, mirroring the teacher's left hand. When the number of balls in one group is four and one in another group is five, then the teacher asks students to add up the two.

During this addition process, LM was observed using both hands to count by representing five with the five fingers of his right hand and four with the fingers of his left hand. However, in adding up, there is a mismatch of gestures made by LM. The discrepancy is evident in LM's finger movement, where LM folds its fingers when adding numbers. Originally, LM's right-hand fingers were all open and then folded, the remaining finger being open. Meanwhile, on the left hand, four fingers were open and folded in half, remaining only two fingers. The movement made by LM indicates that LM can properly represent numbers with his fingers, but LM has not been able to link the two representations of his fingers to add them up. LM experienced counterproductive gestures during problem-solving. Finally, with alacrity, the teacher tried to point to the balls, one by one, in turn by saying, "how many are all counted, one…nine." Subsequently, LM directed his attention to the meaning of the problem. Then, LM was asked to write the number nine on the work the teacher's active involvement in guiding LM to successfully sheet. This activity shows complete integer addition operations.



T : how much is this? Let's count! One, two, ... five (points with his right hand and represents a number with his left finger)

LM pointed at what the teacher pointed at and imitated what the teacher was doing (lip movements and left hand movements) accompanied by looking at the teacher's lip movements

T : well five, plus how many is seven? (uses two fingers to represent the addition symbol and the number 7)

LM observes the teacher's movements while nodding and looking like she understands it

T : Here are seven taken by five (signs with his fingers) how many are left? Count one, two, three, four, five, six, seven. Now, how much is taken of these five, how much is left? (Folding his fingers to leave a symbol of two)

LM followed what was exemplified by his teacher and folded his fingers until the number symbol two remained on his finger

T : (the teacher also taught L what to do) by helping to fold his fingers, how many are left now? Duu-a, how about 2?

LM tried to follow the movement of the teacher's lips and wrote down the second answer on her sheet

T : good (by giving thumbs up to LM)

Figure 2. Interaction 2 in learning the concept of subtracting integers

Figure 2 shows the interaction of the teacher and LM when completing integer subtraction operations. As with the previous problem, this problem is associated with spherical objects (concrete objects). The teacher begins by pointing at the "ball" image, and then LM follows, pointing at the "ball" image. The teacher tries to help LM explain the meaning of the problem by pointing and calling numbers sequentially and repeatedly to ensure the LM's focus. LM demonstrates attentive engagement by closely observing the teacher's lip movements. Next, LM tried to follow every movement made by the teacher. Initially, LM represents the number seven by opening all the fingers on his left hand and opening two fingers on his right hand. Then, LM folds his fingers to represent the subtraction operation. But in this process, when LM wanted to fold the fingers of his right hand, the teacher redirected LM's attention to folding the fingers of his left hand. The awkward gesture made by LM was seen from the expression on LM's face, fixated on the teacher's assistance to fold the finger to find a solution. This condition indicates that the teacher's dominant role is guiding LM to solve the problem of integer subtraction operations. This gesture discrepancy indicates that LM is distracted by the integer subtraction operation.

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The subsequent learning activity involves the process of deepening the material. LM is given tasks related to addition and subtraction of integers with the same problem situation independently. While solving the problem, LM looks serious working, accompanied by gestures, as shown in Figure 3.

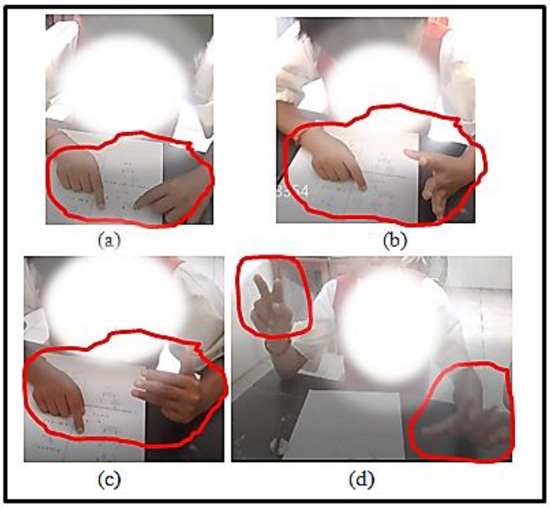

Figure 3. Gestures made by LM while solving problems

As illustrated in Figure 3, the problem solved by LM pertains to the addition of objects in the form of balls. This problem was the initial problem before LM proceeded to the addition of integers with abstract number symbols. The problem aligns with the material covered by the class teacher during the mentoring. In detail, Figure 3(a) shows LM pointing to objects to focus on the problem. After that, in Figures 3(b) and 3(c), LM moves his left finger to icon the number he is thinking about.

LM's gesture in symbolizing the numbers nine "9" and two "2" with his fingers is in accordance with the method demonstrated by the teacher during learning. Furthermore, LM is observed pointing back at the objects on the paper and making icons with his left finger. After LM felt that she knew the numbers she had to add using her fingers, LM calculated with her fingers. As shown in Figure 3(d), LM uses his two ladder fingers to represent the two numbers to be added. The two fingers are dynamically moved by LM, opening, and closing, as LM tries to count and find the answer. However, the obtained answer does not align with the right answer, as shown in Figure 4.

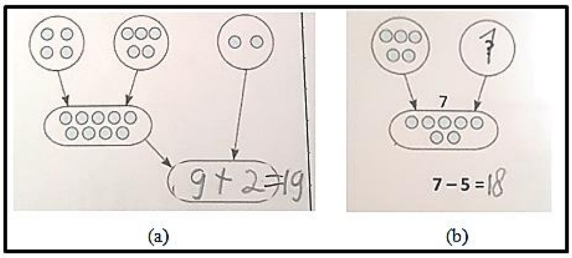

Figure 4. The results of LM's work on adding and subtracting integers

From Figure 4 (a), LM solves the problem incorrectly despite correctly representing numbers on objects using abstract symbols or by using representational gestures with both fingers. However, LM faces issues in accurately executing the addition operation. This discrepancy is notable when LM solves the problem. As shown in Figure 3(d), LM uses his fingers but deviates from the source (teacher) during the previous learning assistance. This pattern of mismatch gestures seems similar to LM's approach in solving integer subtractions, as shown in Figure 4(b). If traced further from the LM gesture in solving the problem presented in Figure 4(a), "9+2=19" arises from a repetitive opening and closing of the finger representing the number nine. LM's gesture affects the resulting sum of the numbers because the number nine is repeated twice.

As practiced by LM, in the process of solving the addition and subtraction operations, counterproductive gestures are prone to occur, as characterized by the observed mismatched gestures. This indicates a disturbance in LM's observation of the teachers' gestures, resulting in LM's difficulties in perceiving, analyzing, or determining the concept of integer operations, both addition and subtraction operations. The distraction is triggered by the imbalance of LM's approach in observing addition and subtraction problems, as well as planning solutions for addition and subtraction. This cognitive process is referred to as the pseudo-process, denoting a series of actions to solve problems heavily influenced by counterproductive gestures leading to incorrect answers.

The cognitive structure of the slow learners engaging in this pseudo-process is illustrated in Figure 5.

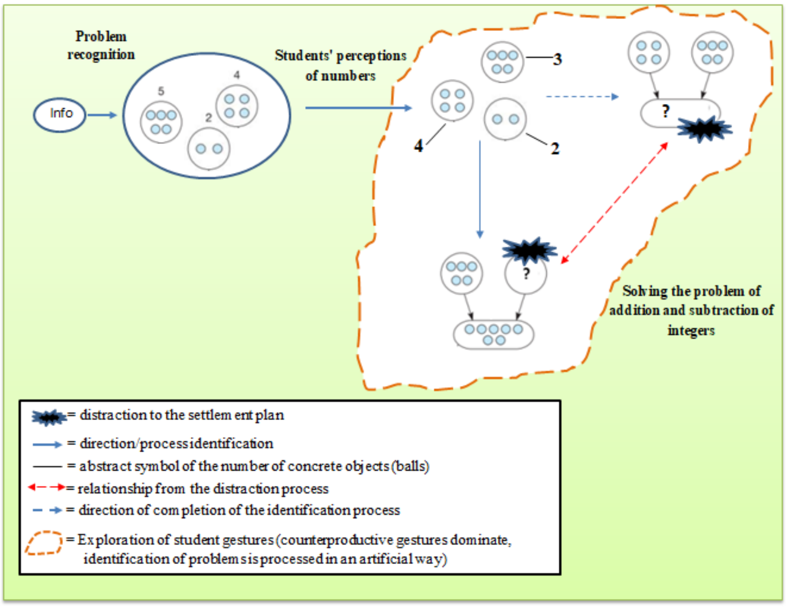

Figure 5. LM's cognitive process in solving problems is dominated by counterproductive gestures

Figure 5 shows that while identifying the number of balls in one circle, LM effectively determines the number of balls LM is able to symbolize the number using his fingers correctly. However, with the addition of the two balls, LM is unable to solve the problem correctly despite using a gesture to symbolize the two numbers. At this stage of the thinking process, LM presents a clear understanding of the problem. After understanding the problem, students try to plan a solution by adding up the two numbers using their two fingers. However, in its execution, LM experienced an error in the problem-solving process. These errors originate from the misunderstanding of the counterproductive gesture that arises during the addition of integers. Further, this misunderstanding is also inappropriately adopted and applied in the subtraction of integers. This underlies LM's thinking process using an inappropriate process.

4. Discussion

Based on the analysis results, in the initial learning phase, the teacher uses a lot of pointing and representational gestures. These movements are employed by the teacher as a strategic approach to direct SL students to focus on specific points. Wakefield et al. (2019); Elvierayani & Susanti (2018) underscore the supportive role of gestures in learning. Gestures are effective as a communication tool for students with special needs, as well as being a tool or strategy in the process of learning mathematics. Sumaji et al. (2020) emphasizes that mathematical communication can lead to conceptual understanding, problem-solving, and mathematical reasoning. Ruhama et al. (2018); Hord et al. (2016) assert that the gesture is made by the teacher, particularly the pointing and assertive speech. It serves as a potent tool for conveying information and providing support to students in explaining mathematical concepts or ideas within the dynamics of mathematics learning conversations. In addition to pointing and representational cues accompanied by assertive speech, in providing feedback to learner students, the teacher explains or elaborates mathematical concepts, ideas, and statements, as well as justifying student answers.

This study also indicates that slow learner students have not been able to perceive the concept of adding and subtracting integers, even though concrete objects have been adopted. Slow learners heavily rely on their teacher to understand the problems by paying attention to the teacher's instruction. Likewise, during learning, when students try to understand concepts, the teacher seems to dominate students, possibly hindering the absorption of information by SL students. Therefore, in the future, teachers in special education are expected to adopt teacher-less dominant teaching approaches, employing strategies that facilitate optimal material absorption. Linearly, Morales-martínez & Mezquita-hoyos, (2022) reported that cognitive evaluation of students offers valuable insights for teachers to gauge student knowledge and tailor their teaching accordingly. Despite the previous assumption that slow learner students predominantly possess a high visual learning style, in this study, we observed that students still experienced counterproductive gestures in learning mathematics, especially in basic arithmetic operations (addition and subtraction of integers). Fundamentally, arithmetic forms a crucial foundation taught at the elementary level, and any challenges in understanding basic concepts like adding and subtracting integers can pose significant obstacles in a student's mathematical learning journey. As explained by NCTM that algebra, known for its strength in generalizing and solving a range of problems, builds upon the foundational understanding of arithmetic (NCTM, 2000). Carraher *et al* Carraher et al. (2006) also emphasizes that learning algebra represents a transition from learning arithmetic. However, if students experience obstacles in this transitional learning, their future algebra learning will be impeded.

The problem given to SL students involve the addition and subtraction of visual objects, because the learning of students with special needs starts from the concrete to the abstract. The results of the study confirm that SL students are visual learners. They demonstrate the ability to identify the number of objects in the addition and subtraction questions if presented in a visual form. However, SL students struggle to add the numbers when these concrete objects have been represented in mathematical numbers. This is in line with the findings reported by Murdiyanto et al. (2023); Shaw (2010); Chauhan (2011) that SL students have difficulty understanding abstract problems. Their ability to deal with abstract and symbolic material is very limited, while their reasoning capacity in practical situations is lower than that of the average student. In addition, a study from. Mustafa et al., (2016) also suggested that autistic students produce several types of gestures in the learning process. One of the gestures involves inappropriate movements or facial expressions while observing, pointing, and uncovering or calling out objects being observed.

Perceptions created by SL students are associated with other problems, particularly noticeable when students attempt to solve the problem of adding integers. Their initial perception, often incomplete or inaccurate, continues to influence subsequent problems, including those related to subtraction. This subsequent issues can be influenced by students' incomplete understanding, as reported in research by Afriyani et al. (2018) that students' flexible understanding consists of complete and incomplete flexibility. The association scheme by students simultaneously and sequentially shows their minimum capacity to make abstractions from the mathematical objects. Apart from that, other influencing factors can come from the difficulties of slow learner students obeying rules and have low abilities. Self-esteem problems in slow learner students make it difficult for them to gain recognition, respect, attention and affection from others so that they feel they don't have much to be proud of and have few superior qualities (Trisnani et al., 2023).

The findings in this study suggest that SL students often focus more on observing the teachers' lip movements (the other person) compared to the movements of other body parts (fingers, arms, and hands). Consequently, SL students struggle to understand the meaning conveyed through other body movements (fingers, arms, and hands). Besides, SL students always exchange gestures with the teacher during learning by repeating the movements from the teacher. However, in solving problems, we observed a mismatch between their gesture and the gesture from the source (teacher). In completing the addition and subtraction of integers, slow learner students frequently replicate specific hand movements, thereby, they use a single approach for the problems. Furthermore, students' difficulties in making abstractions on the addition and subtraction of integers which are expressed through the production of counterproductive gestures, cause students to experience distraction easily. Thus, they experience mismatched gestures in solving addition and subtraction problems.

5. Conclusion

The process of solving the problem of addition and subtraction operations performed by SL students often involves counterproductive gestures as characterized by their mismatched gestures. Their heavy reliance on counterproductive gestures results in errors when solving problems. Many of the motoric movements of SL students are carried out spontaneously and are not in accordance with the problems. Further, during the learning, SL students mostly focus on observing the teacher's lip movements compared to the teacher's hand movements in explaining mathematical concepts. This distraction leads to the manifestation of counterproductive gestures, impeding the students' ability to solve problems accurately. This study also illustrates the teacher dominance in the learning of SL students. Therefore, in the future, teachers are expected to adopt improved teaching methods or strategies to facilitate optimal comprehension and absorption of information by SL students.

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