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EXPLORING THE IMPLEMENTATION OF AN INTERVENTION FOR A PUPIL WITH MATHEMATICAL LEARNING DIFFICULTIES: A CASE STUDY

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Abstract

This study presents a single case study of how a remedial mathematics teacher incorporated an instructional intervention into her teaching practices in order to teach counting to a pupil with mathematical learning difficulties. This new theory-driven intervention was developed by the authors of this study. Dyscalculia is a term which refers to a wide range of mathematical learning difficulties or disabilities. Dyscalculic pupils have a specific mathematics learning disorder with a core deficit in representing and processing of numerosity. They might not be able to recognise numerical quantities, performing counting and so on. Early supports such as interventions have a great potential in helping dyscalculic pupils to improve mathematical skills. However, there remains a lack of appropriate instructional scaffolds to help dyscalculic pupils to organise their learning structures by addressing both cognitive deficits and mathematical skills. The present study involves a primary school remedial teacher, Daisy, and an at-risk dyscalculic pupil, David, both pseudonyms. Data were collected through interviews, lesson observations, and reflective journals. The findings revealed that the proposed intervention improved the counting ability of the pupil.

Keywords: Reconnecting Learning, Intervention, Learning Disability, Dyscalculia, Mathematical Learning Difficulties

Abstrak

Penelitian ini menceritakan tentang sebuah studi kasus tunggal tentang bagaimana seorang guru matematika menggunakan intervensi instruksional dalam mengajar berhitung kepada siswa dengan mengalami kesulitan belajar matematika. Intervensi berbasis teori baru ini diciptakan oleh para peneliti dalam penelitian ini. Diskalkulia adalah istilah yang mengacu pada berbagai jenis kesulitan atau ketidakmampuan belajar matematika. Siswa dengan diskalkulia memiliki gangguan belajar matematika yang spesifik yaitu kekurangan dalam permisalan dan pemprosesan bilangan. Mereka mungkin tidak dapat mengenali kuantitas numerik, melakukan perhitungan dan sebagainya. Dukungan awal seperti intervensi memiliki potensi besar untuk membantu siswa dengan diskalkulia untuk meningkatkan keterampilan matematika mereka. Namun, ada kekurangan scaffolding pengajaran yang tepat untuk membantu siswa dengan diskalkulia untuk mengatur struktur pembelajaran mereka dalam mengatasi defisit kognitif dan keterampilan matematika. Penelitian ini melibatkan seorang guru sekolah dasar (Daisy-nama samaran) dan seorang siswa yang berisiko mengalami diskalkulia (David-nama samaran). Pengumpulan data dilakukan melalui wawancara, observasi pembelajaran dan jurnal reflektif. Hasil penelitian menemukan bahwa intervensi yang diusulkan dapat meningkatkan kemampuan berhitung siswa.

Kata kunci: *Reconnecting Learning*, Intervensi, Ketidakmampuan Belajar, Diskalkulia, Kesulitan Belajar Matematik

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Research into learning difficulties and learning disabilities has progressed considerably in recent decades. This indicates growing concern about learning difficulties and learning disabilities, particularly in the context of mathematics. From the perspective of mathematics education, mathematical learning difficulties or disabilities are of paramount importance, as these relate to educational inequalities (Deruaz et al., 2020). Barriers to learning mathematics impede access to and

participation in various learning activities; therefore, educators should seek ways to support this group of pupils and provide them with equal opportunities for learning mathematics. The purpose of this paper is to introduce and demonstrate how an intervention may be useful to support pupils with mathematical learning difficulties or disabilities in particular the learning of counting. Pupils must master counting, because it is one of the most foundational skills in mathematics and is a critical prerequisite for the development of basic addition facts (Cotton, 2016).

Mathematical learning difficulties (MLD) or disabilities are referred to as dyscalculia (Deruaz et al., 2020). Dyscalculia is due to core deficits in representing and processing numerosities (Butterworth, 2019). Numerosity refers to the size of a set and relates to the question 'How many?' (Kadosh & Dowker, 2015). Pupils with dyscalculia are known as dyscalculic pupils. They have no number sense, cannot perform subitizing, and are unable to recognise and remember mathematical symbols (Emerson & Babtie, 2014; Wang et al., 2016). Research shows that the prevalence rate of dyscalculia is about 3-6% of the population (Bird, 2017). Westwood (2015) indicated that a critical problem is that very young dyscalculic pupils fail to make a correct one-to-one correspondence between the spoken number and the pointed object in a sequence.

Even though dyscalculia is not rare, there is no standard process in place for dyscalculic pupils to receive sufficient educational support (Morsanyi et al., 2018). Wijaya et al. (2019) indicated that 48% of 28 Indonesian teachers performed re-teaching to overcome students' learning difficulties, while 31% conducted drills and practices and only 17% of the teachers developed or planned new teaching strategies. This indicates that most teachers had limited strategies to support students with mathematical learning difficulties.

Dyscalculia needs to be assessed separately to evaluate individual's cognitive strengths and weaknesses, and it has very straightforward implications for designing the appropriate intervention strategy (Butterworth, 2019). He further stated that intervention must strengthen the basic capacity to represent numerosities as sets and understanding basic number concepts (Butterworth, 2019). This would explain the complexities in designing appropriate interventions in remediating dyscalculic pupils. Deruaz et al. (2020) concluded that there is a need for further research with pupils with dyscalculia to develop remedial intervention related to both pedagogy and mathematical content and how a teacher can help at-risk dyscalculic pupils to learn counting effectively. Individuals who have been diagnosed with dyscalculic tendencies via a dyscalculia screener or other standardized instruments are categorized as at-risk dyscalculic pupils. These pupils require effective and efficient instructional intervention so that they do not continue to fall behind their peers (Emerson & Babtie, 2014; Morsanyi et al., 2018). Therefore, this study aims to contribute by introducing a potentially useful instructional intervention, which is known as Reconnecting Learning. This study explores how a remedial teacher has implemented Reconnecting Learning, to teach counting to an at-risk dyscalculic pupil in a remedial mathematics class.

Current Interventions for Teaching At-Risk Dyscalculic Pupils

Research studies have revealed that early interventions show great potential for teaching at-risk dyscalculic pupils (Dowker, 2017; Butterworth, 2019). Researchers have proposed that pedagogical interventions can enhance dyscalculic pupils' mathematics learning, such as the Multisensory Teaching approach (Emerson & Babtie, 2014), the Concrete-Representational-Abstract approach (Bird, 2017), Intervention using an abacus (Lu et al., 2020), intensive intervention (Bryant et al., 2014), integer module intervention (Bryant et al., 2020), intervention combining many evidence-based practices (Powell et al., 2020), intervention based on best instructional practices (Van Garderen et al., 2020), and game-type intervention (Laski & Siegler, 2014). Other studies reported that dyscalculic pupils may gain substantial improvement through technology-based interventions such as computer-based intervention programs (Butterworth & Laurillard, 2010) and Augmented Reality (AR) technology (Miundy et al., 2017).

The aforementioned early mathematics interventions have yielded promising results in contributing to the basic numeracy development of dyscalculic pupils. However, Dowker (2017) argued that these interventions may not focus on cognitive deficits and mathematical skills. Cognitive deficits refer to deficits in representing and processing numerosity. This incomplete evidence may prevent early mathematics interventions from improving numeracy skills of at-risk dyscalculic pupils. The development of mathematical competency begins with the understanding of numerosity and the relationships among numbers (Gebuis & Reynvoet, 2014). Numerosity processing is demonstrated in the performance of numerosity comparison or numerosity judgment tasks (Gebuis & Reynvoet, 2014). Examples include, enumerating small sets (counting) and naming the number of objects in a display are the simple activities for measuring numerosity processing (Butterworth, 2019). Butterworth (2019) further suggested that mathematics educators should design specific interventions and theory-driven assessments for each learner. Appropriate learning strategies should be the focus of these interventions and assessments. In the present study, a theory-driven specific intervention namely Reconnecting Learning is formulated to fill in the aforementioned research gaps. This intervention aims to contribute to the teaching of counting to at-risk dyscalculic pupils by taking into account the cognitive deficits of dyscalculic pupils.

Reconnecting Learning Intervention

Reconnecting Learning is an instructional intervention that has been developed by blending Tall's (2013) theory of mathematical thinking and Feuerstein's (2015) structural cognitive modifiability theory, because remediation is essential to explore teaching at-risk dyscalculic pupils from different perspectives. Reconnecting Learning aims to help at-risk dyscalculic pupils to learn counting skill. The intervention lasted a week and comprised two 30-minute sessions. Counting may be a difficult process for young learners (Villarroel et al., 2011). This is because counting can become an increasingly abstract process (Voutsina, 2016). Counting is initially a highly complicated combination of speaking number

words and pointing at objects in succession, stopping with the number at the last object pointed at (Tall, 2013). This invites the question of what abilities are needed in order to comprehend counting.

Humans are born with three abilities, namely recognition, repetition, and language (Tall, 2013). Humans can recognise patterns, repeat an action, and use language to name and refine concepts. All of these underpin the development of Reconnecting Learning. There are three steps in Reconnecting Learning, namely Demonstration, Mediation, and Active Learning. As an illustration, a pupil recognises that the last number in a counting sequence is the total number of objects in that collection. The pupil can visualise the counting process in a demonstration, then can count repeatedly to strengthen one-to-one correspondence counting in the mediation step. The pupil uses language to reason the way to get the answer in the active learning step.

Tall's (2013) theory explains how children learn counting naturally. However, it may not sufficiently address dyscalculic pupils' difficulties. As mentioned previously, the core problem of at-risk dyscalculic pupils is cognitive deficits in representing and processing of numerosity (Butterworth, 2019). Feuerstein et al. (2015) confidently speculate, pending further confirmation that structural cognitive modifiability theory may modify an individual's structure of neuroplasticity. Hence, it is possible to unlock individual's potential by modifying pupils' thinking both cognitively and motivationally, to help at-risk dyscalculic pupils to learn counting by blending Feuerstein's (2015) structural cognitive modifiability theory with Tall's (2013) theory.

The theory of structural cognitive modifiability emerges naturally through Mediated Learning Experience in educational context (Feuerstein et al., 2015). There are three vital parameters of Mediated Learning Experience, namely (1) mediation of intentionality and reciprocity; (2) mediation of meaning; and (3) mediation of transcendence. In our research context, mediation of intentionality may mean that a teacher demonstrates how to count to an at-risk dyscalculic pupil and make sure the pupil is giving positive feedback, so that the demonstration can be continued. Then the teacher mediates the meaning of counting to the pupil. Finally, the teacher bridges the idea of counting using language with the at-risk dyscalculic pupil (Feuerstein et al., 2015).

METHOD

This study employed a case study research design to collect the relevant qualitative data. It was carried out at one of the national primary schools in Malaysia. A two-tier purposive sampling technique is chosen. Merriam and Tisdell (2016) stated that a two-tier purposive sampling is necessary in qualitative case studies when there is a general question that an in-depth study of a particular occasion will elucidate that interest. In the first tier, we screened 15 primary year one pupils by using the Malaysia Dyscalculia Instrument MDI (Wong et al., 2016). One at-risk dyscalculic pupil, David (pseudonym) was identified. In the second tier, the remedial teacher, Daisy (pseudonym) was chosen because she was David’s remedial teacher and had the responsibility to help David to master basic numeracy skills. She had 24 years of teaching experience. Daisy completed a two-day Reconnecting Learning training course

prior to implementing it in her lessons. Daisy and David participated this study voluntarily. Data were collected through an in-depth interview with Daisy, classroom observations, and analyses of Daisy's reflection journals and David's worksheet. One of the aims of this study is to explore how does Daisy implement Reconnecting Learning to teach counting to the at-risk dyscalculic pupil, David. This study also explores the impacts of Reconnecting Learning, seeking to answer two specific research questions as follows:

1. How does the teacher implement Reconnecting Learning to teach counting to the at-risk dyscalculic pupil?
2. To what extent does the implementation of Reconnecting Learning support the achievement of the intended learning outcome, which is being able to count 1- 10?

Background of the Research Participants

Reconnecting Learning was conducted in a one-on-one setting. A remedial mathematics teacher and an at-risk dyscalculic pupil were involved in the study. David was a Year One pupil, and his chronological age was seven years old. Malaysia Numeracy Remedial Assessment (MNRA) is a numeracy screening instrument that aims to identify at-risk pupils, and it helps remedial teachers to prepare and design remedial teaching and learning activities (MOE, 2012). Based on his past MNRA result, he has been categorized into a group which indicates that he did not master pre-numbers and number concepts and that he could not recognise numbers.

Daisy is a female teacher with 24 years of teaching experience. Daisy followed the guidelines provided in the training course to prepare her daily lesson plans and teaching resources. She always recorded her reflections immediately after the lessons. Daisy had two mathematics lessons (30 minutes in each lesson) with her year one numeracy remedial pupils on every Monday and Friday.

Data Collection and Analysis

Data were collected through multiple sources during the one-week intervention. We examined Daisy's journal reflections, David's worksheets, triangulate with the lesson observations data and the 30 minutes in-depth interview to ensure trustworthiness (O'Leary, 2014). These journal reflections serve as the primary data of this study (Yin, 2018). Daisy always wrote her journal reflections after her lessons. Two formal classroom observations were conducted by the researcher. Anecdotal notes and pictures were taken during the observations. Rich data sources are crucial to capturing Daisy's multifaceted patterns of thoughts, beliefs, and values that underlie her teaching experiences (Yin, 2018). After the classroom observations, a 30-minute in-depth interview was conducted to allow Daisy to reflect on her experience of implementing the intervention and to explore her perceptions regarding Reconnecting Learning.

Data from journal reflections, interview transcripts, and anecdotal notes were analysed using Clarke and Braun's (2013) thematic analysis. The analysis involved four steps. In the first step,

categories were created based on indicators that emerged from the journal entries which are considered relevant to Reconnecting Learning and the research questions. In the second step, the interview data were transcribed from the audio recordings. In the third step, data from Daisy's reflective journals, interview transcripts, and classroom observation anecdotal notes were compared respectively, and new categories of data will be created if necessary. In the last step, we evaluated the reliability of the themes by re-reading and re-analysing the coding concepts and ensured no new themes were uncovered, in order to promote the trustworthiness and rigor of the findings.

RESULTS AND DISCUSSION

Two main themes emerged in the present study: (1) Reconnecting Learning is an instructional-based intervention; and (2) Reconnecting Learning appears to be a potentially useful intervention for teaching counting to the dyscalculic pupil. This section provides a case profile of Daisy's teaching process. The case description clarifies how she implemented Reconnecting Learning to teach counting to an at-risk dyscalculic pupil in her remedial lessons.

Theme 1: Reconnecting Learning as A Structured Approach Intervention

The results presented in this section are used to answer the first research question. Reconnecting Learning is a structured approach intervention which focuses on teaching counting for at-risk dyscalculic pupils. Daisy organised each lesson into three distinct phases, namely Demonstration, Mediation and Active Learning.

Demonstration

Daisy demonstrated how to count the pips on domino cards to David.

Daisy: Good Morning, David. Are you ready for today's lesson?
David: Morning… (He nods his head.)
Daisy: Do you notice what is this? (She displays the domino cards and numbers in front of David.)
David: Number… card (He urges to touch the learning materials)
Daisy: These are domino cards and numbers.
David: (He nods his head.)
Daisy: Do you like to play counting game? We are going to learn counting today.
David: Yes…
Daisy: Good. Let's start our game. Our mission is to find out how many pips altogether in domino number cards.

Daisy demonstrated how to count the pips on each mathematics domino cards by using point to count strategy (see Figure 1). Daisy spoke the number words aloud and pointed to the pips in correspondence then told David that the final spoken number word represented the total number of pips.

David: (He looks at the ground)
Daisy: Look here (pointing at the pips), do not look at the ground.
David: Eight. (He stared at the mathematics domino cards.)
Daisy: How do you know?
David: I saw it.

Figure 1. Daisy demonstrated point to count strategy

In the interview, Daisy elaborated that:
"Firstly, I demonstrated how to count using mathematics domino cards, he (i.e., David) was urged to touch the learning materials."

She further explained:
"At first, he felt so shy and nervous in my class. Then, when I took out the mathematics domino cards…oh…He realised that the teacher wanted to play a game with him. Then he felt more relaxed, then he was excited to touch the domino cards."

Demonstration can capture pupils' attention and provide opportunities for teachers to introduce and explain concepts in a highly visual and auditory way (Ware & Johnson, 2013). In Reconnecting Learning, Intentionality and Reciprocity were embedded in the demonstration. Intentionality means the mediator's effort to change a child's attention and perception (Feuerstein et al., 2015). This was achieved by telling David the learning objectives of the lesson and demonstrating the counting process so that

David can focus on the recognition of quantity. To ensure that David was paying attention to the lesson, Daisy gave explicit instructions by saying “Look here (pointing at the pips), do not look at the ground.”

Intentionality cannot stand alone without the pupil's reciprocity (Feuerstein et al., 2015). Reciprocity refers to the learner responds vocally, verbally, or non-verbally to the teacher's behaviour (Feuerstein et al., 2015). David responded by nodding his head and said, "I saw it." Daisy realised there was a positive change in David’s attitude and was motivated to learn and urged to touch the domino cards during the demonstration.

Mediation

David was engaged in the lesson, and he was motivated to speak aloud the number when he was counting. Daisy led David to do the counting and pointed at the corresponding pips concurrently. David can verbally count "one, two, three …nine " in Malay.

When Daisy asked David: "How many pips are there on the domino card?" David looked around and paused for a while, then he started to count verbally: "one, two, three, four, five" and answered "five" in Malay. Daisy explained to David, "Just now you counted the pips from the right lattice, how about you try to count the pips from the left lattice?" David counted and gave the same answer "five." Mediation of meaning happened when Daisy grabbed David's dominant hand (i.e., right hand) to count the pips on the domino cards by using point to count strategy (see Figure 2). Daisy explained in her interview, "I mediated him by grabbing his hand to mediate the meaning of counting…. erm….one-to-one correspondence to him…" In Daisy's reflective journals, she remarked her teaching and learning went on smoothly and David could focus his attention all the time.

Figure 2. Daisy grabbed David's right hand to count the pips on the domino cards using point to count strategy

Mediation of meaning happens when a teacher conveys the main point and the purpose of an activity to a learner in both cognitive and affective levels during the interaction (Feuerstein et al., 2015).

Using Reconnecting Learning, Daisy aimed to convey the meaning of how to count to David. As Gelman and Gallistel (1978) pointed out, there are three 'how-to-count' principles namely the one-to-one principle, the stable-order principle, and the cardinal principle. In this case, the one-to-one correspondence principle means only one numeral can be given to each item in a set. The stable-order principle denotes that the numerals used to count must be used in the same order in any one count. The cardinal principle means the numeral, or the last word spoken in counting a set of items represents the total number of items in the set (Gelman & Gallistel, 1978).

This mediation phase aimed to teach the one-to-one correspondence principle and stable order rule to David. Daisy interpreted the mediation phase as grabbing David's dominant hand to do the counting together and pointing at the corresponding pips concurrently. From the observation data, David could verbally count "one, two, three …nine " in Malay. This data show that he could speak one numeral for each item in a set and followed the same order in any one count. This is supported by Feuerstein et al. (2015), who state, "Do it through me, and with me. Don't do it for me". Additionally, Daisy tried to mediate the meaning of the order-irrelevant principle to David. Per the observation data, Daisy challenged David whether he could get the same answer as he started to count the pips from right to left and vice versa. Then, David tried to count the pips start from the right lattice, then he continued to count the same number of pips from the left lattice using the point to count strategy. Finally, David got the same number of five pips. From this activity, Daisy tried to mediate the meaning that the order in which objects are counted is not important to David. As a consequence, David could count the pips in all instances. David could count correctly because he could apply the one-to-one correspondence principle using the count all strategy and he stated the last number as the amount of the set. From the affective perspective, David was motivated to learn during the mediation phase as he was willing to speak aloud the number when he was counting and completed the small tasks assigned by Daisy. For example, Daisy asked David to count the pips from the left lattice. Daisy's reflection journal stated that David could concentrate on his learning during the mediation process. The mediation of meaning helped David to learn how to count cognitively.

Active Learning

Active learning means pupils are intensely engaged in both mental and physical exercises during the learning process (Green & Casale-Giannola, 2017). David was encouraged to choose his favourite domino card and perform point to count during the active learning phase (see Figure 3). In the reflective journals, Daisy remarked: "During the active learning phase, David was encouraged to choose his favourite domino card and perform counting. I will give him minimal guidance if he makes mistakes…" During the lesson, it was observed that Daisy facilitated David carefully and motivated him to choose his favourite domino card for counting. Daisy's intention was to allow David to comprehend and make sense of counting by himself with minimal guidance. Mediation for transcendence was embedded in active learning. Mediation for transcendence is characterized by going beyond the pupil's concrete

context or the knowledge (Feuerstein et al., 2015). In this case, mediation for transcendence is evidenced by the fact that David could match the numeral with the correct quantity of pips but not just merely being able to repeat the process of counting the pips. Daisy mediated David to go beyond the how to count knowledge, David was able to recognise the numbers and match them with the correct quantity of pips. At last, David learned how to count through Reconnecting Learning, consisting of three systematic learning processes: demonstration, mediation, and active learning.

Figure 3. David performed point to count by using his index finger

Theme 2: Reconnecting Learning Appears to be A Potentially useful Intervention for Teaching Counting to the Dyscalculic Pupil

The result presented in this subsection is used to answer the second research question. In the interview, Daisy explained that David did not know how to express quantity prior to implementing Reconnecting Learning:

> "*He didn't know how to count using his fingers. Erm… I asked him to show me seven using his fingers, he failed to do that, I don't know why…*"

After the lessons, Daisy said, "It was great that David mastered counting after the remedial session." The results show that David was able to count 1-10 using domino cards and match the quantities of pips with the correct numerals during the lessons. In addition, David was able to count and match the quantities of sandwiches with the numbers in the worksheet correctly (see Figure 4). He was able to represent the quantities using numbers in two different instances.

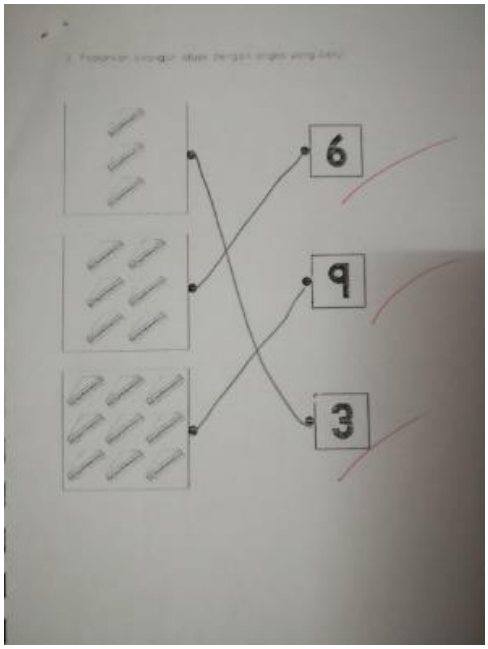

Figure 4. David counts and matches the quantities with the numbers correctly in the worksheet

Daisy' reflective journals indicate that Reconnecting Learning is a practical intervention, as David can pay attention and learn counting easily in a one-to-one setting. She remarked:

"After carried out the remedial activity, I felt that one-to-one setting in Reconnecting learning is practical. My pupil can pay attention more easily."
"I use mathematics domino cards in my teaching and learning activity. My pupil can learn more easily using the learning material."

Moreover, Daisy also illustrated:

> *"After the training, I learned how to teach at-risk dyscalculic pupils…Erm… Reconnecting Learning can motivate my pupils to learn mathematics, it is different from other teaching strategies that I had learned before…"*

She further elaborated that Reconnecting Learning includes some significant elements of social aspects that is valued and loved:

> *"He loves teacher to touch his hand, he felt he is valued and being loved. I think this part is the most different from other teaching strategies. I learned and felt this step is so motivated."*

The affective responses of David coupled with the involved cognitive processes had supported the achievement of the intended learning outcome. In short, the implementation of Reconnecting Learning has supported the achievement of the intended learning outcome cognitively and affectively.

Our purpose was to describe Reconnecting Learning for teaching counting to the at-risk dyscalculic pupil and to highlight that the intervention shows promising results for supporting the pupil to learn counting. Dyscalculic pupils do not stagnate in their learning development if they are given sufficient time and appropriate intervention (Emerson & Babtie, 2014). David did not know how to express quantity prior to implementing Reconnecting Learning. Building on these circumstances, David was able to recognise the presented quantity of pips and he was able to repeat the demonstrated counting action. He used language to speak aloud the number words while counting and reasoning his experiences after this remediation.

This study provides a significant window into the way that Daisy demonstrated how to implement Reconnecting Learning that involved three main steps. She began with Demonstration and intentionally provided David with the first input regarding counting with one-to-one correspondence using mathematics domino cards. In the Mediation step, Daisy and David counted the pips on the mathematics domino cards together by grabbing David's dominant hand to point at the pips. Daisy explicitly delivered the counting principles: one-to-one correspondence principle and cardinal principle to David. In the Active Learning step, David actively engaged in the activity, and he was able to count the pips on the mathematics domino cards in a correct correspondence. Finding reveals that the blending of Tall's theory (Tall, 2013) and the theory of structural cognitive modifiability (Feuerstein et al., 2015) to perform instructional intervention to help at-risk dyscalculic pupils to learn counting skill was successful. The findings are consistent with the study of Aunio et al. (2021) that investigated if early numeracy skills of 267 at-risk of mathematical learning difficulties children in South Africa can be improved with an intervention program. The main result shows that the intervention group had improved more in numerical relational skills as compared to the control group. Aunio et al. (2021) implemented explicit mathematics instruction intervention program and included the cognitive measures in their intervention study. They focused on language skills and measured executive function through recording the children's reaction times and accuracy of their answers per item whereas the present study focused on how an at-risk dyscalculic pupil processed and represented numerosities by collecting qualitative evidence. The present study fills the gap in the literature by focusing on the abilities of processing and representing numerosities of dyscalculic pupils.

In addition, the present study has exemplified the gradual release of responsibility model of instruction which was proposed by Fisher and Frey (2013). The model is about an instructional teaching design for a continuous shift of the cognitive load across time. Learners' cognitive load should gradually and purposefully shift from instructor modelling to joint accountability between teachers and pupils, and then to independent practice and application (Pearson & Gallagher, 1983). The gradual release of

responsibility model of instruction was exemplified through the present study by focusing on teaching counting to an at-risk dyscalculic pupil in a one-on-one setting.

The present study is supported by Vygotsky's sociocultural theory which claims that cognitive development needs to happen within a social context (Gauvain, 2008). For example, Daisy acted as a mediator to convey mathematical concepts to David using language and David reacted by giving positive feedback to Daisy when learning counting. David can engage in more complex cognitive activities, such as counting with the assistance of Daisy through the sociocultural approach.

At the end of the intervention, David was able to count the sandwiches and match the quantities with the numbers correctly in his worksheet. This shows that David was able to process and represent the quantities using numbers in two different instances. Activities such as counting and naming the number of objects in a display are the measurements for numerosity processing (Butterworth, 2019). Reconnecting Learning was able to tackle the cognitive deficits in processing and representing numerosities and develop counting skill for the at-risk dyscalculic pupil. Consistent with Butterworth (2019), in order to assist dyscalculic pupils in making progress, interventions should emphasise on developing pupils' basic capacity to represent numerosities as sets and link them to number words and numerals. Teachers may guide pupils carefully from concrete work to abstract work. In this context, Daisy used mathematics domino cards to illustrate quantities and adapted her teaching to fit David's current level of understanding of the subject.

CONCLUSION

Daisy implemented Reconnecting Learning by organising her each lesson into three distinct phases, namely Demonstration, Mediation and Active Learning. The empirical evidence indicates that Reconnecting Learning did support the achievement of the intended learning outcome which is being able to count 1-10.

The study clearly has limitations. Even considering the limitations in terms of the sample size and the relatively narrow focus of the study, there are some implications that are evident. Reconnecting Learning was successful in helping Daisy to teach counting to the at-risk dyscalculic pupil, David. As numerous previous studies have discussed remedial interventions focused on teaching strategies (devices, tools, interactions) designed to help students progress, rather than students' cognitive abilities (Deruaz et al., 2020), the main contribution of this study is the introduction of Reconnecting Learning which is a potentially useful intervention to help at risk dyscalculic pupils to learn counting cognitively. Further research should be undertaken with a larger sample size and a broader content focus to investigate the effectiveness of Reconnecting Learning in teaching mathematics to at-risk dyscalculic pupils.

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