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ARTICLE

A case study of an after-school teacher-led small-group mathematics intervention program for students in a bilingual Vietnamese primary school.

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Abstract
This case study evaluated the effectiveness of an after-school mathematics intervention program for students with mathematical learning difficulties (MLD) in a Vietnamese bilingual primary school, examining both academic performance and self-confidence outcomes over twelve weeks. Using a mixed-methods approach, the study collected data through classroom observations, semi-structured interviews with teachers and a school psychologist, and an analysis of standardized test scores. The intervention group consisted of seven primary-level mixed-ability learners. The findings demonstrated significant improvement in academic performance across all participants, with knowledge gains ranging from 25% to 50% over the twelve-week period. The teacher-directed methodology, while predominantly traditional, proved effective when combined with consistent error correction, mathematical dialogue, and regular parental communication. Notably, one student who switched to private tutoring showed the highest improvement (75%), suggesting the potential benefits of one-on-one instruction. The study's most interesting implication lies in its revelation that while teacher-directed methods can be effective for MLD students, there remains significant untapped potential in incorporating more interactive, student-centered approaches and manipulatives. This suggests that traditional intervention methods could be enhanced by integrating more dynamic teaching strategies, particularly given the timing of after-school sessions when students are typically fatigued.

Introduction
This case study will evaluate the effectiveness of an after-school mathematics intervention club on the academic achievement and self-confidence of pupils with mathematical learning difficulties (hereafter referred to as MLD). These classes are held in L1, in a bilingual school in Vietnam.

There are seven primary-level mixed-ability learners in an intervention group who took part in an hour-long after-school mathematics club. The schoolwide mathematical MOET (Ministry of Education and Training) test scores of pupils in this group ranged from 0.5 to 1.7, and they were assigned to the after-school mathematical classes (redacted, 2023) (see appendix 1) since they performed below the expected level in tests.

Background to the Intervention:
The extracurricular activity policy of the school categorizes three types of students who are obliged to enrol in the after-school program:
1. Students with low-academic attainments:
- Students with unsatisfactory entrance assessment results (according to the school's assessment process);
- Students who fail the MOET test in their first year;
- Students who are recommended by subject teachers;
2. Students with learning difficulties.

The student’s academic and after-school program progress is evaluated by:
1. MOET initial assessment; 2. MOET final assessment at the end of each semester (Yusupov, 2023).
In the first school year, many learners encounter issues in acquiring numeracy knowledge, which in turn causes learners to fall behind in schoolwide standardized tests, which draws the school’s attention to arranging a tailored program for low achievers in mathematics.

The Learning Issue
In Vietnam, mathematics is one of the core disciplines of most concern (Trines, 2017) and one of the most complex abstract sciences for many young learners, not only in Vietnam but throughout the world (Yusupov, 2023). Undoubtedly, having poor numeracy skills entails pupils' daily life challenges in and out of school (Douglas, Clements, & Sarama, 2011). In the school context, failure in the development of early numeracy ability can cause slow progress in important disciplines in higher grades, such as history, geography, IT, chemistry, and physics (Krutetskiy, 1976). In the broader sense, taking into account psychological factors, thinking mathematically plays a crucial role in shaping children's cognitively foundational brain (Yusupov, 2023), metacognition, and flexible cognition (Chinn, 2021), which helps them to be successful in school, higher educational settings, and later in their future jobs (Yusupov, 2023).

The research question of this case study would be how effectively a tailored intervention designed by the school for learners with MLD led to an increase in academic performance and to enhance their self-confidence in mathematics at the end of the semester, which has been held over the course of twelve weeks in private bilingual primary school in Vietnam.

A range of resources have been reviewed:
- to figure out the stem of intervention learners' MLD;
- to characterize their MLD condition;
- to evaluate implemented best practices in the after-school program by intervention teacher;
- to draw important conclusions about the intervention and whether it achieved success or failure.

Literature review

The word 'math' is from the ancient Greek language 'mathema', which carries the meaning 'that which is learnt', 'matic' comes from 'matos', which means 'willing to (perform)' (Staves, 2018). Its initial meaning comes from being 'willing to learn' which can be applied to anything around us (Staves, 2018). Ernest et al. (2016) interpret mathematics as 'new glasses,' which, according to Krutetskiy (1976), can show the world brighter only via 'mathematical eyes' (Krutetskiy, 1976, p. 235). Nowadays, technology is everywhere in our lives which is a perfect visible example of 'mathematics is everywhere' (Staves, 2018, p.8,). It has been reported in the study of J Fred Bucy et al. (1989) that mathematics is the summary term of technology, which is indeed the simplest and biggest opportunity of the world to demonstrate to society how mathematics plays a powerful role in it (Colli, Nemenzo, Polthier and Rousseau, 2014).

A strong point and nationwide consequences of mathematics education as an investment of governments summarized by Dianes (1966) & Aikenhend (2017) and J Fred Bucy et al. (1989) as follows:

1. it can attract more young generations to mathematics exploration;
2. it can result in increasing mathematical literacy in the country;
3. it entails filling business and industry job opportunities;
4. it sharpens a country's global market competitiveness;

Conversely, a lack of attention to mathematical education might cause the nation to fall behind in employing advanced technologies, communicating with the global industrial labor market, and inadequate management and government decisions (Aikenhend, 2017). Hence, successfully surviving in the technology-based world intertwines with high-quality mathematics education at school (Steen, 1989).

Issues in Learning Mathematics
The most frequent interrelated issues pupils indeed encounter within mathematics:

1. Mathematics Learning Difficulties (see appendix 2);
2. Mathematical Anxiety (Hereafter MA);

Mathematical Anxiety (MA)

Dowker et al. (2016) suggest two separate dimensions of MA, cognitive and affective that are characterized by Chinn (2021) as two types of MA, one of which is caused by mental blocks during the process of gaining knowledge and the other one due to socio-cultural factors.

MA is characterized as a feeling of tension, apprehension, and fear (Donlan (1998) that interferes with the application of practical and academic mathematics solving problems (Dowker et al. 2016) and can cause dyscalculia (Chinn, 2021). However, Chinn's (2021) and Skemp's (1987) research illustrate that anxiety does not always carry a negative meaning. Conversely, it can be facilitative anxiety, which motivates and alters behavior effectively, whereas debilitative anxiety inhibits or alters behavior ineffectively (Chinn, 2021 & Skemp, 1987). Consequently, it can affect the degree of anxiety (Chinn, 2021), low, medium, and high anxiety (Hopko et al., 1998).

It was proposed by Hopko et al. (1998) that anxiety arises in three central behavioral systems: physiological, verbal (cognitive), and overt (behavioral), which is called a triple response framework of emotion. The researchers report that individuals with mathematics anxiety consistently demonstrate physiological arousal and low self-esteem in problem-solving activities (Hopko et al., 1998). Chinn (2021), and Szűcs (2019) highlight its three interrelated causes: 1. Environmental; 2. Intellectual; 3. Personality.

Hence, researchers conclude that MA's features are as follows (Cambridge Mathematics, 2017):

- MA is associated with poor performance;
- MA anxiety may be both mental and emotional;
- MA arises to affect a significant proportion of students at schools and university of all ages, as well as adults; females report it more than males;
- Teachers who experience MA can transmit it to pupils.

Mathematics issues in Vietnam

Researchers report that some factors hinder learners' achievement in mathematics in a nationwide context:

- lack of attention by local government in inner disadvantaged areas of the country (UNICEF, 2015);
- a big educational gap for children with disabilities (UNICEF, 2015);
- inaccessibility to quality education by ethnic minority learners (UNESCO, 2013);
- teachers' challenges with a mathematical curriculum based on competency-oriented from MOET 2018 (Nguyen et al., 2020)
- keeping traditional behaviorism and constructivism learning (Nguyen and Pham, 2018);
- teacher's test or examination-oriented approach (Trung et al., 2019);

In the school context, Tran et al. (2019) demonstrate seven factors of slow learners in mathematics:

1. students limited cognitive capabilities;
2. lack of parental support for home learning;
3. overloaded mathematics syllabus;
4. insufficient classroom hours for teachers to provide individualized support;
5. students' lack of concentration and motivation for learning;
6. teachers' inadequate understanding of the characteristics and needs of slow learners;
7. limited school facilities.

With all the above-mentioned, there is another contributing factor to the Vietnamese children's low achievement in mathematics. As stated in the study of Mcaleavy et al. (2018) teachers' low income makes them do a part-time job to support their families rather than attending CPD training to enhance subject and pedagogical knowledge. William (2008) highlights that a lack of CPD causes teachers' under-confidence in teaching mathematics.

Good practices in mathematics intervention classes

One of the most reliable solutions to support low-attaining children in catching up with peers, enhancing grade-level knowledge, and gaining subject confidence, which helps them meet national expectations in mathematics, is targeted intervention classes (see appendix 3) with effective teaching methods (Nelson & Powell, 2017; Williams, 2008; Dowker, 2009).

Kadosh and Dowker (2015) state that effective mathematics teaching or learning is based on two theoretical foci – a Piagetian focus on learning and a Vygotskiian focus on teaching. It is informed by observations of Bold (2001) that a great part of effective teaching depends on how teacher and pupils develop their constructivist approaches, such as mathematical dialogue based on numeracy language, gestures, movements, and even non-verbal glances. Morris (1984), based on Heinrich Bauersfeld's study, also supports the constructivist method, saying that effective mathematical teaching-learning is realized via teacher-learner and peer interaction. For instance, fruitful teacher-learner interaction, speaking and simultaneously gesturing of the teacher, and instructional conversations are defined as external forms that shape learners' internal forms, which lead individuals towards well-formed (correct and mathematical advanced) (Kadosh & Dowker, 2015). Hence, successful mathematics teaching is to use an individual's internal forms in action to form actions with external forms nurtured by a teacher (Kadosh and Dowker, 2015).

It was stated that there should be distinctive and tailored teaching instructions for learners with MLD (Noel & Giannis Karagiannakis, 2022), which implies instructions are indeed delivered by applying different techniques. Walker (2021) recommends that students need additional mathematics practice since many of them need a second chance to review the content. According to researcher "Math sometimes just doesn't transfer as quickly as it does for other kids" (Walker, 2021, p. 118). Additionally, intervention teachers' roles should greatly involve corrective and re-teaching functions (Noel & Giannis Karagiannakis, 2022), which are not supposed to engage pupils with new insights, conversely, help them enhance grade-level mathematics knowledge.

Meta-analysis of intervention pupils conducted by Hattie (2009) found direct-instruction to be one of seven effective intervention teaching practices which were supported by findings of many researchers such as Skemp (1987), Krutetskiy (1976), Walker (2021), Thompson (2010), Noel & Giannis Karagiannakis (2022), Lerman (2014), Kadosh & Dowker (2015) and Chinn (2021). However, Thompson's (2010) lesson observations show that the whole-class teacher-directed question-and-answer teaching style was identified as a less helpful method for learners' lifelong learning, yet it was implemented by both effective and less effective grade-level teachers, not by intervention teachers. Hattie (2009) characterizes teaching techniques of direct instruction that a teacher needs to encourage pupils to learn, create deliberative activities and modeling, and provide explicit and immediate feedback with multiple opportunities for intervention pupils.

Noel & Giannis Karagiannakis (2022) suggest the most efficient seven remediation strategies for pupils with MLD based on a meta-analysis:

1. explicit instructions;
2. visual representations;
3. student verbalization;
4. using multiple instructional examples;
5. use of heuristic/multiple strategies;
6. providing on-going feedback;
7. peer-assisted mathematics instruction.

The aforementioned instructional strategies for pupils with MLD can be seen in other researchers' effective teaching recommendations, such as William (2008), Dowker (2009), Thompson (2010), Walker (2021), and WWC (2021). On top of that, there are two more factors that can contribute to a teacher's good teaching in intervention classes: active parental involvement in kids' school life Kadosh and Dowker (2015) and active interaction between intervention and grade-level mathematics teachers (WWC, 2021).

Hence, the above-mentioned best mathematics practices for both pupils with and without MLD can be demonstrated only by teachers who are still active learners (Skemp, 1987) by means of participating in CPD training (Williams, 2008) to enhance subject and pedagogical knowledge (Balls, 2008).

Methodology

This case study was carried out based on mixed-method research (MMR), which Jennifer Greene names "a mixed methods way of thinking" (Leavy, 2017, p. 168). MMR is a credible method in terms of involving both quantitative and qualitative data collection (Cohen, Manion & Morrison, 2018) and integration in a single project, which results in a holistic understanding of the case under investigation (Leavy, 2017). Cohen, Manion & Morrison (2018) single out some valid reasons why MMR is the most credible research design for the case study, and they claim that MMR has a great impact on increasing the accuracy of data and reliability via triangulation; in turn, it reduces bias in the research, provides a more practical, problem-driven approach in research, and enables compensation between strengths and weaknesses of research strategies (Cohen, Manion & Morrison, 2018). My three methods of data collection were interviews, observations, and secondary data.

The first method utilized in this case study was observations, which are described as the art of 'seeing data' (Ioanna Palaiologou, Needham & Male, 2016, p. 146). It provides a researcher with a vivid coincident of teaching theory in the classroom, enables one to collect an immediate empirical insight, demonstrates mundane routines and activities of the research, and creates an opportunity for documenting essential aspects of the investigation, such as verbal, non-verbal, and physical (Clark et al., 2009). In the current case study, a semi-structured type of observation was chosen, and the researcher played a complete observer role in collecting empirical evidence (Cohen, Manion & Morrison, 2018) and making field notes to build up a broader and more vivid picture of the intervention (Gray, 2004). To increase the validity of data in a complete observer role, techniques suggested by Ioanna Palaiologou, Needham & Male (2016) were taken into account during the observation: use only five senses (taste, smell, touch, hearing, and vision) without intervening or interacting with intervention learners or a teacher.

The second method was interviews, which were of significant importance in bridging empirical and theoretical evidence of the case study (Leppink, 2017). The method interviews were selected based on Kvale's view, which determined two different approaches as a 'miner' and 'traveller' (Cohen, Manion & Morrison, 2018). According to Kvale, both 'miner' and 'traveler' seek insights into a particular subject, and assume only the interviewee has those precious insights (Cohen, Manion & Morrison, 2018). If the latter is intended to extract invaluable insights from the interviewee, the former is as a partner of the interviewee traveling into an unknown world to co-construct knowledge in a particular case (Cohen, Manion & Morrison, 2018). From several types of interviews, a semi-structured one was employed with its appropriate criteria, such as recording the interview (Gray, 2004) and standardized open-ended interview questions for the participant to fully express their responses in as much detail as desired (Turner, 2010) to obtain best qualitative data. Out of the three significant proposed points by Cohen and Manion in Gray's (2004) study, the third one highly mattered in this case study, which can be used in conjunction with other research methods, such as in the current context, observation, and secondary data, to follow up issues.

The third method employed was secondary data collection, which provided a researcher with rich quantitative data to determine the effectiveness of the conducted intervention. The researcher of the current case study did not have direct access to pupils' quantitative MOET test results, so the secondary data collection was considered as the best way to obtain it via a lead teacher in mathematics (Cohen, Manion & Morrison, 2018). The secondary data analyses involve existing data of a particular group or, in the current context, pupils' before and after intervention schoolwide test scores which increases its validity in conjunction with the above two methods in this case study (Gray, 2021)

In order to bring theoretical knowledge with three qualitative and quantitative data collection methods and to demonstrate whether the after-school program was successful or not, the instrument triangulation method was implemented (Cohen, Manion & Morrison, 2018), by means of which the most accurate and descriptive data is produced and the chance of accidental or coincidental outcomes is reduced (Walker, 2021). It occurred as follows in ABC Triangulation formula:

Insights after having read plenty of resources about (A) learners' mathematical issues their causes in primary school learners; (B) good teaching techniques in intervention class; (C) gathered secondary data via a lead teacher were practically justified by utilizing the mentioned three methods:

- Interview + A = justification (IA); 2. Observation + B = justification (OB); 3. Secondary data collection + C = justification (QC);
- Instrument Triangulation (Analysis of findings) = IA+OB+QC.

Ethics

During this case study, in an ethical research context, the BERA guidelines were followed (BERA, 2018) to create mutual trust and a safe and friendly environment in intervention classes and with teachers. Researcher participation in making field notes was carried out only with the consent of the school and teachers involved. All data in the study was kept entirely anonymous, and intervention pupils were not made aware that a study was taking place.

Data collection

Observations (see Appendix 4)

Classroom visits:

Intervention class visits were held over a period of six weeks. Before visiting classes, the researcher obtained permission from the head of the primary school and English department (see Appendix 4).

Collection summary of observations (see appendix 5)

In both group 1 (hereafter G1) with two pupils and G2 (hereafter G2) with five pupils, it was highly likely a teacher-directed method with a few effective teaching techniques such as checking pupils' homework and class error correction, modeling mathematical problem solutions on the whiteboard, the mathematical errors' discussion, teacher-pupils interactions by questioning, peer-correction, effective monitoring pupils' practice and immediate feedback on their errors, highlighting pupils errors with red marker, giving pupils opportunity to share their mathematical solutions, using ICT effectively, giving some time for thinking, practicing mathematical language by class choral drilling, and providing voice equity. Unfortunately, in G2, most intervention classes were conducted monotonously by means teacher's sitting next to two pupils, using tailored worksheets, communicating, and guiding pupils in mathematical problem-solving.

Semi-structured informal interviews

Informal interview with G1 intervention teacher, G2 intervention and grade-level teacher who is the same person, and school psychologist. Before making an appointment with teachers and school psychologists, the researcher had invited them to get an interview by using school email and messenger (see Appendix 5). All interviews were recorded and scripted by listening to them several times. Questions were generated based on literature to know better pupils' cognitive, physical, and social issues in learning mathematics and a few questions about teaching methodology.

Collection summary of informal interviews: (see appendix 6, 7)

Interview with a G1 intervention teacher

Both pupils were diagnosed with ADHD according to a teacher, pupil M mostly struggles with lesson focus and is always keen on holding objects in his hands, and is an active learner. However, M progressed a lot, particularly in self-study at home without their parent's assistance. A pupil, N, also struggles with lesson focus, and a teacher shared something related to ADHD, which led me to make an appointment with a school psychologist to know it in depth.

Interview with G2 intervention and grade-level teacher

All five pupils have mostly mathematical content problems. However, learner M, according to a teacher, has innate language disorder (dysarthria), learner S has difficulty focusing on the lesson and always needs the teacher's extra attention, which shows us ADHD with inattention diagnosis, another learner struggles to remember some mathematical facts, has short memory.

Interview with school psychologist

A learner N in G1 was officially diagnosed with ADHD with low IQ and had attended a special ADHD intervention class before attending the current school in September 2023. In general, he does not have any social problems with his classmates, except with one learner with social-emotional difficulties. Learner N has a sudden fear in his eyes even when teachers approach him, pointing to something in his notebook to assist as if a teacher is about to do physical harm. According to a psychologist, this fear stems from physical punishment done by his parents at home.

Secondary quantitative data

In a postponed meeting to 2024 with a lead teacher of primary level mathematics, I could obtain quantitative data of all intervention pupils' MOET test scores from September 2023, which determined all pupils to be assigned to intervention classes, and from December 2023, after twelve weeks of intervention classes.

Discussion

Looking at Table 1, Table 2, and Table 3 pupils' MOET test results in December, it is clear that the intervention program was effective in increasing pupils' mathematical academic achievement. In the current school, learners who are below the minimum score of standardized tests are called pupils with learning difficulties (redacted, 2023) (see appendix 1) which is one of the diagnostic methods to determine low achiever pupils (Dowker, 2009).

In Table 1, we can see all learners' low grades in September and achieved scores in December, which demonstrates how effectively teachers and pupils worked on mathematical development during the twelve weeks.

TABLE 1: Pupils gained Mathematics knowledge

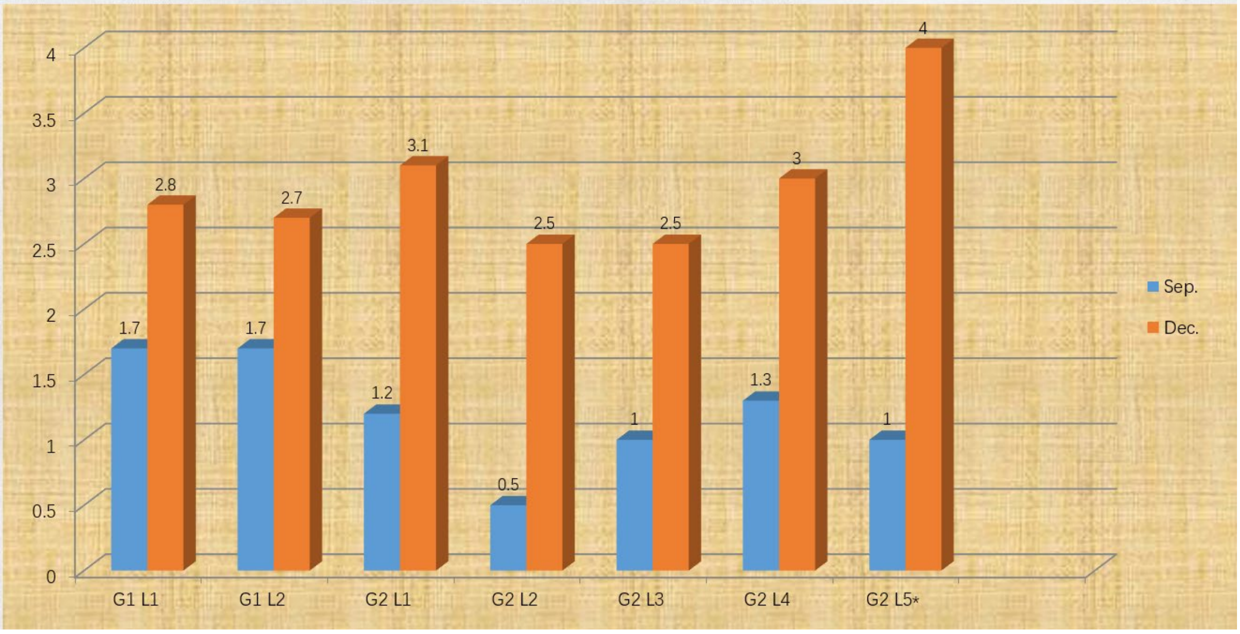
MOET test The highest score: 4 The minimum score: 2 The lowest score: 1	G1L1	G1L2	G2L1	G2L2	G2L3	G2L4	G2L5
SEPTEMBER (BEFORE INTERVENTION)	1.7	1.7	1.2	0.5	1	1.3	1
DECEMBER (AFTER INTERVENTION)	2.8	2.7	3.1	2.5	2.5	3	4
SEPTEMBER (BEFORE INTERVENTION)	42.5%	42.5%	30.0%	12.5%	25.0%	32.5%	25.0%
DECEMBER (AFTER INTERVENTION)	70.0%	67.5%	77.5%	62.5%	62.5%	75.0%	100.0%
Increased Mathematics knowledge in 12 weeks	27.5%	25.0%	47.5%	50.0%	37.5%	42.5%	75.0%
Monthly Increased Mathematics knowledge	9.2%	8.3%	15.8%	16.7%	12.5%	14.2%	25.0%
Weekly Increased Mathematics knowledge	2.3%	2.1%	4.0%	4.2%	3.1%	3.5%	6.3%
Increased mathematics knowledge in one lesson	1.1%	1.0%	2.0%	2.1%	1.6%	1.8%	3.1%

Nearly all pupils' low scores range from 1 to 1.5; even one pupil, G2 L2, demonstrated the worst performance with the lowest score of 0.5, which is equal to 12.5% of the required score of 100 %. The rest of G2 learners' test scores percentages vary from 25% to 35%. As for G1 learners, both of them, G1 L1 with ADHD features and L2 ADHD pupil with low IQ, reached 42.5 % of the maximum score, which was lower than the minimum. The interesting fact is that there is a numeracy growth in all pupil's mathematics, excluding G2 L5, ranging from 25% to 50 % during the twelve-week intervention classes. More precisely, G1 pupils on average grew their knowledge from 25% to 30% during 12 weeks, from 8% to 9.5 % in a month, from 2% to 2.5% every week, and from 1% to 1.5% in every lesson.

As for G2 pupils', excluding G4 L5, gained numeracy knowledge during the twelve weeks varied from 35% to 50%, monthly from 12.5 % to 16 %, weekly from 3% to 4.5%, and in a lesson from 1.5% to 2.5%. There is an L5 who stopped participating in after-school mathematics classes after the researcher's observations due to some reasons. However, according to an intervention teacher, L5 kept having extra mathematics cases with a private tutor as one-to-one, which performed the highest score among all intervention pupils, gaining 75% knowledge during twelve weeks. It can be a good example of a 'wave 3' model intervention framework where a learner is supported by a specialist teacher to deliver one-to-one lessons to achieve very specific targets (Dowker, 2009).

TABLE 2: Pupils gained Mathematics knowledge

Months	G1 L1	G1 L2	G2 L1	G2 L2	G2 L3	G2 L4	G2 L5*
September (Before intervention)	1.7	1.7	1.2	0.5	1.0	1.3	1.0
December (After intervention)	2.8	2.7	3.1	2.5	2.5	3.0	4.0



Although all primary-level pupils could significantly improve their numeracy skills, the interesting fact is the difference between G1 and G2 pupils' gained knowledge percentages, and it is highly likely to bring up how intervention lessons were delivered in both classes.

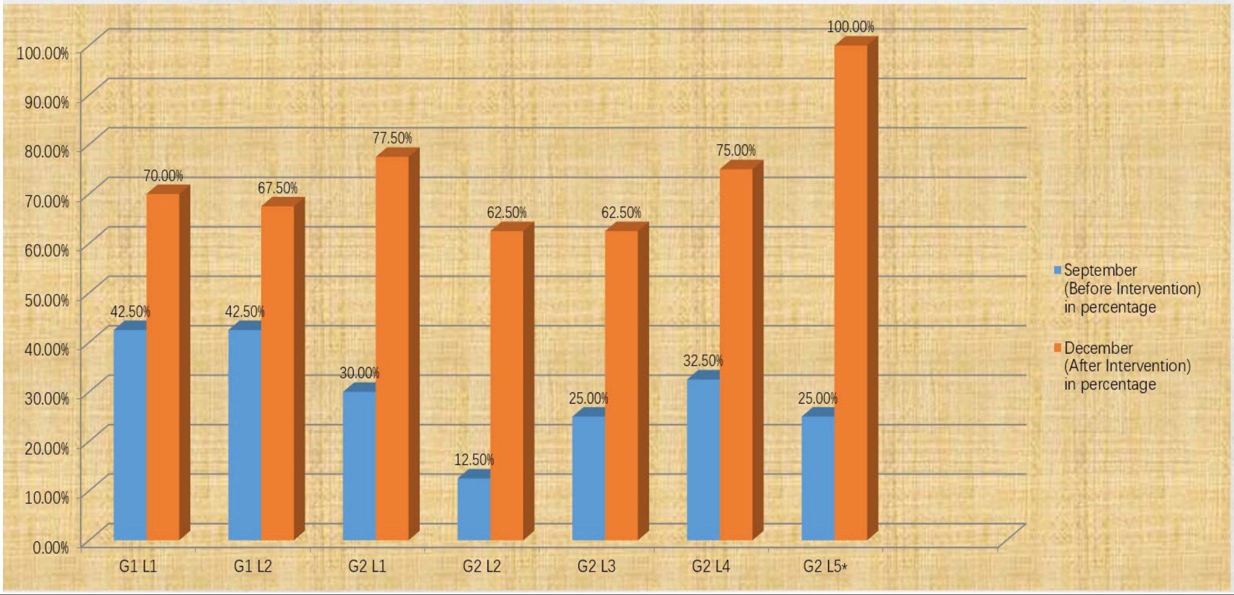
Both teachers usually started their lessons after collecting pupils' homework worksheets or writing some mathematics problems on the board which encouraged learners to raise their hands and solve those problems. According to intervention teachers, it was a quick warm-up activity from pupils' homework worksheets (Interview G1&G2 teachers, 2023; see appendix 6,7). Specifically, wrong solutions were demonstrated on the whiteboard for learners' wrong answer recognition and revising previous learning. It is stated that intervention classes need to include systematic reviews (WWC, 2021), and allow learners to be able to see the mistakes because mistakes are common occurrences in all classrooms which should be corrected by peers (Walker, 2021).

It has been suggested by the current school's policy that the content of lessons delivered by intervention teachers should be the same as in the classroom lesson content (redacted, 2023) (see appendix 1).

From field notes and interviews with both teachers, it has been found that G1 and G2 teachers always tried to build good relationships with their learners in order to create a friendly and positive learning atmosphere in the classroom. It is said that teaching and learning, with an understanding of the subject matter, can be based only on mutual dialogue between a learner and a teacher (Skemp, 1987). However, the G1 intervention teacher had difficulty with both G2 pupils at the beginning of the intervention due to their ADHD behavior. For example, in the week 1 observation, the G1 L2 pupil did not want to repeat aloud after a teacher or read mathematical problems on the worksheet, and several times, he sighed very loudly and just ignored the teacher. He was almost about to cry when he could not solve the problem (Teacher notes, week 1, see appendix 4, 5;). According to Anobile et al. (2022), ADHD children are sensitive to their failure and external criticism, which can cause their negative behavior.

TABLE 3: Pupils gained Mathematics knowledge

Month	G1 L1	G1 L2	G2 L1	G2 L2	G2 L3	G2 L4	G2 L5*
September (Before intervention) (%)	42.5%	42.5%	30.0%	12.5%	25.0%	32.5%	25.0%
December (After intervention) (%)	70.0%	67.5%	77.5%	62.5%	62.5%	75.0%	100.0%



Over the period of six weeks, both teachers used finger gesture techniques to elicit the responses, think aloud, model the mathematics problems with their solving strategies on the whiteboard, and simultaneously interact with pupils. Teachers could explicitly react to pupils' verbal wrong answers by their facial expressions or keep silent to let learners know their wrong responses (Teacher notes, 2023) (see appendix 4, 5;). Such type of teaching method is supported by Bold (2001), who that mathematical interaction is based on explicit numeracy language, gestures, movements, vivid modeling of solution strategy and even non-verbal glances. However, in G2, all those occurred on learners' worksheets, not on the whiteboard. In the interview with the G2 intervention teacher, a question was asked to find out the reason why the teacher did not use a whiteboard: 'I had only two learners with behavior difficulties and I did not find it effective to write any mathematics problems on the whiteboard, particularly when they both were very super active and could be easily distracted by anything around them' (see appendix 6,7).

It was observed that both teachers actively used the teacher-directed techniques during the six weeks. In both classes, the teacher engaged pupils with questions, and the answers were written on the whiteboard, except in G2 (Teacher Notes, 2023; see appendix 4, 5). Furthermore, a G4 teacher allowed pupils to come up to share the answers on the whiteboard, sometimes, more than two pupils were at the whiteboard to demonstrate their solutions (Teacher notes, 2023; see appendix 4, 5;). It has been reported in Thompson's (2010) observations that whole-class question-and-answer teaching styles were applied by both effective and less effective teachers. On top of that, question-answers teaching styles were highly supported to teach learners with MLD (Kadosh & Dowker, 2015; Chinn, 2021). In this stage, the teacher could have engaged the learners with interactive whiteboards (Williams, 2008; Dowker, 2009), which were quite available in their classroom, or the think-pair-share technique, which could have extended their sharing time for a collaborative problem solution (Noel & Giannis Karagiannakis, 2022).

The other contributing factor to the effectiveness of the intervention is teacher and parent communication. Conducted interviews with teachers (see Appendix 6,7) and school intervention policy (redacted, 2023) inform that (see Appendix 1) intervention teachers needed to communicate with pupils' parents face to face or on the school parental communication platform every two weeks about learners' performance. It was reported that some parents were consistently happy to discuss their child's progress after the class. William (2008) highly recommended involving parents in children's mathematical learning, in particular in intervention classes, which, according to Kadosh & Dowker (2015), affects children's school life and success in all subjects.

In summary, and with reference to, the literature on MLD and MA, the findings from conducted interviews, observations, and secondary data collection and analysis demonstrate that after-school mathematics class is effective in supporting a group of pupils with MLD and with low confidence to increase their academic achievement and self-confidence in mathematics.

Conclusion

The findings of this case study suggest the intervention class effectively helped all pupils to overcome their mathematics anxiety and mathematics learning difficulties, which most definitely had a great impact on meeting their academic target and increasing self-confidence in learning mathematics. There is, however, some failure in relation to utilizing more learner-centered teaching strategies with more hands-on activities and manipulatives, which indeed lead learners to successfully connect the most abstract science mathematics to the real world, which is the real target of Vietnamese mathematical education and school.
The aforementioned quantitative and qualitative data illustrate that in a period of six weeks, the teacher-directed or paper-pencil method was actively employed to deliver extra mathematics classes, which is also highly recommended by researchers to teach pupils with difficulties. However, in the current school circumstance, more interactive and student-centered learning could have been implemented with learners. Since pupils attended intervention classes after long and tiring school days, there would be some evidence-based suggestions recommended by WWC (2021), Dowker (2009), and Williams (2008) to implement in the future:

1. Utilizing all available resources in the classroom, such as whiteboard;
2. Engage learners with manipulatives;
3. Using more interactive visual and physical activities such as videos, songs, and games;

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Appendices

Appendix N1

School Extracurricular policy [redacted for publication purposes].

Appendix N2

Mathematics Learning Difficulties (MLD)

In studies, the term 'mathematics difficulty' is used to represent students with performance in the low average range, as well as students with a diagnosed math disability such as dyscalculia (Nelson & Powell, 2017) the literal meaning of which is an inability to calculate (Dowker, 2009).

There are many factors that can cause MLD. In the broader sense, MLD can arise from genetic, cognitive, and neuroscientific perspectives (Fritz et al. (2019), brain injuries, and disabilities such as Down syndrome (DS) or Williams syndrome (WS) (Lerman, 2014). In the narrower sense, MLD stems from socioeconomic factors, complex interactions between individual differences, and contextual factors, such as public policies, poverty, culture, school, classroom effects, and the quality of teaching pedagogy in the classroom (Fritz et al., 2019). One of the primary issues affecting mathematical learning, along with other subjects, is attention deficit hyperactivity disorder (ADHD) (Colomer et al., 2013) and developmental language disorder (DLD) (Fyfe et al., 2019). Hence, three types of difficulties underlined by Dowker (2009), Anobile et al. (2022) and Fyfe et al. (2019) directly cause learners some areas of cognition in learning mathematics:

1. Language difficulties; 2. Spatial difficulties; 2. Memory difficulties;

The interesting psychological factor of MLD causes function in children's brains, as given by Krutetskiy (1976) and Skemp (1987) in regard to mathematical symbols. Skemp (1987) states that mathematics is crucial only with its two types of symbols, visual and verbal, which are frequently hard for children to succeed in. The table illustrated by the researcher includes the right and left hemisphere of the human brain and their functions. According to the table, the right hemisphere of the brain is responsible for visually (Skemp, 1987) receiving and successfully assimilating symbols in the schemas, which then will be integrated into the left hemisphere of the brain, which is responsible for language and social cognition (Huff, Mahabadi and Tadi, 2022). By drawing on Genking's electrophysiological studies, Krutetskiy (1976) has been able to show a comparison of two regions of the brain in regard to causing difficulties in assimilating mathematical symbols in schemas. The study has reported that mathematically incapable children's operation with mathematical symbols induces a comparatively strong response by the optical regions of the cortex (Krutetskiy, 1976), which is located in the right hemisphere of the brain, responsible for receiving visual-spatiality information (Huff, Mahabadi and Tadi, 2022), and in comparison with the inferior parietal region of the brain (Krutetskiy, 1976) in the left hemisphere of the brain responsible for language and social cognition (Huff, Mahabadi and Tadi, 2022), whereas considering neurological concepts, just a reaction of the inferior parietal region is adequate for operating with symbols (Krutetskiy, 1976). Thus, children can encounter grasping difficulty in learning mathematical symbols which occurs due to a strong reaction of optical regions of the cortex, but it is successfully operated in the parietal region of the cortex.

Appendix N3

Mathematics Interventions

Researchers have developed various credible intervention frameworks such as 'Response to Interventions' (RTI) (Hinton, Flores & Shippen, p. 190, 2013) and the 'Waves model' (Dowker, p. 8, 2009), which were designed to meet student's educational needs (Hinton, Flores & Shippen, 2013) and minimize underachievement of learners (Dowker, 2009). For a mathematical intervention to succeed in an RTI framework, comprehensive supplemental mathematics interventions have to incorporate arithmetic operation fluency, problem-solving, and the use of iconic representational altogether (Hinton, Flores & Shippen, 2013).

Interventions need to consider students' specific learning difficulties in mathematics, and the students will be accordingly assigned to targeted mathematical programs. In the RTI instance, there are plenty of interventions, such as mathematics interventions for problem-solving, computation, and number sense, which include evidence-based instructions and methodology recommendations to implement (Hinton, Flores & Shippen, 2013). On top of that, it was found in Dowker's (2009) review of numerous mathematics interventions designed based on wave 1, wave 2, and wave 3 model with outcomes of what:

Wave 1: to provide all children with quality first teaching;
Wave 2: to support children just below national expectations in a small group intervention program;
Wave 3: to support lowest attaining children in an individual or very small group basis with trained teachers);

Hence, interventions are one of the most reliable solutions to support low-attaining children in catching up with peers, enhancing grade-level knowledge, and gaining subject confidence, which helps them meet national expectations in mathematics.

Appendix N4
[redacted for publication purposes]

Appendix N5
<u>6 WEEK TEACHER OBSERVATION NOTES</u>
[redacted for publication purposes]

Appendix N5 (Summarized observation notes from six weeks)
In group 1 (hereafter it is G1), with two male learners, a teacher utilized the one-to-one paper and pencil method almost most of the time, sitting next to them. A teacher always started her lesson by checking solved mathematical problems on a worksheet, which were always taken out from pupils' bags and passed to a teacher's hand, which might probably have been their homework. A teacher usually used her red color pen to highlight the errors on their worksheet, and there was a short teacher-pupil communication where a teacher pointed to something verbally expressing her ideas in L1. In Group 2 (hereafter G2), unlike G1's lesson start, a teacher briefly went through pupils' worksheets and engaged pupils to reflect on their errors on the whiteboard, which were solved by the teacher-guided method. If in G1, all the time a teacher gave one common instruction by verbalizing and writing on a piece of paper in front of them, then while one pupil had controlled practice, another pupil worked independently.

In G2, a teacher always assigned three tasks during the class; in every step, a teacher demonstrated one problem and solution on the whiteboard by communicating and guiding a volunteer to give it a try at solving the problem. Consequently, after exemplifying one mathematics problem solution, pupils wrote it down in their notebooks, and then a teacher displayed a number of the same mathematical problems on the whiteboard using a projector where pupils were given some time to solve problems by themselves. Unfortunately, in G1 a teacher preferred direct communication with pupils by guiding and exemplifying all mathematical problems in the paper.

In G2, while pupils' worked independently, a teacher always closely monitored them, and sometimes, when some errors were seen, a teacher immediately let a pupil know about it. Two pupils volunteered to display their solutions on the whiteboard when time was up, and the rest of the pupils checked and corrected their solutions. A teacher always highlighted pupils' errors on the whiteboard with a red marker. Before highlighting whiteboard solution errors, a teacher always went through some steps: engaged other pupils to correct the errors, then short feedback was provided, after which all pupils could check and correct their solutions.

The other method in both G1 and G2 teachers employed was a class discussion, which was built upon their errors. The G2 teacher always chose one error and displayed it on the whiteboard, probably engaging all pupils with questions. Each of them was allowed to write their solutions at the same time on the whiteboard since the number of pupils was not too many and the whiteboard was big enough for it. When all pupils demonstrated their solutions on the whiteboard, a teacher encouraged each of them to give a brief explanation about their solutions; most of the time, all solutions were the same. However, a teacher always exemplified limited strategies for solutions. Hence, the class discussion was explicitly seen and noticed by an observer of how a teacher communicated with each of them and highlighted their errors with a red marker and again conversation, which led them to problem correction.

The other explicit frequent technique observed in both G1 and G2 groups was how teachers held whole class mathematical choral drilling exercises while one of them did it by writing some problems in mathematical language on the whiteboard and engaged the pupils to repeat it aloud after a teacher, the other teacher conducted it sitting next to two pupils. In G2, after a whole class of choral drilling, a teacher encouraged an individual pupil to read written mathematical problems or vocabulary on the whiteboard.

It is worth mentioning that in G2 a teacher could provide an equity voice during the intervention classes. Unfortunately, in G1, a teacher devoted most of her time to a pupil who had ADHD and low IQ, yet the other also with ADHD with inattention diagnose (according to a grade-level teacher) and gradually progressed his self-study skills, according to the grade-level teacher.

Appendix N6

[redacted for publication purposes]

Appendix N7

Interview with G2 enrichment class Teacher. 23m:36s; In a meeting room A; 1.12.2023 [redacted for publication purposes].