The Fidelity of Implementation and Teachers' Perceptions of the SIMPLE Approach: Evidence from Lower Secondary Classrooms in Kosovo

Qëndresa Morina[1,*], Naďa Vondrová[1]

[1] Faculty of Education, Charles University, M. Rettigové 4, Prague, Czech Republic; qendresamorina@outlook.com

This study is part of broader research focused on the SIMPLE Approach, a constructivist intervention that integrates the bar model method with metacognitive scaffolding to enhance word problem-solving skills in Kosovo's lower secondary classrooms. It specifically examines the fidelity of implementation and teachers' perceptions of this approach. The study aims to fill a research gap in design-based intervention studies, which recognise the critical role of teachers but provide limited insight into their actual work and how faithfully they implement interventions. To address this gap, the study explored two areas: (1) the fidelity of three teachers' implementation of the SIMPLE Approach and (2) the teachers' perceptions of its usefulness. Data collected from classroom observations, teacher diaries, and interviews revealed varying levels of fidelity, which improved over time. Teacher 1 exhibited the lowest fidelity, struggling with the bar model method and limiting group work. In contrast, Teacher 3 demonstrated the highest fidelity, successfully incorporating all aspects of the SIMPLE Approach and promoting active pupil engagement. Regarding their perceptions, all three teachers maintained positive attitudes towards the SIMPLE Approach from the outset and appreciated its benefits by the end of the intervention. Although the generalisability of the findings is limited, they suggest that the SIMPLE Approach holds promise. However, the study highlights the need for comprehensive teacher training and ongoing support, especially when introducing new methods, to ensure effective implementation and high fidelity.

Key words:
bar model, fidelity, metacognition, teachers, word problems.

Received 2/2025
Revised 3/2025
Accepted 5/2025

1 Introduction

Word problems (WPs), an essential component of mathematics education, are a significant topic in educational and research discussions. They consist of particular written mathematical tasks rooted in real-world scenarios that necessitate using mathematical concepts to solve the posed questions. WP solving develops crucial skills, including reading comprehension, problem-solving, and critical thinking among pupils (Pongsakdi et al., 2020; Verschaffel et al., 2020). Despite their importance, WPs often present difficulties for pupils. Research has shown that these difficulties stem from various factors. These factors involve understanding linguistic and contextual information (Verschaffel et al., 2020), converting the problem into mathematical symbols (Pongsakdi et al., 2020), and self-monitoring during the WP-solving process (Verschaffel et al., 2020).

Researchers suggested various methods to aid pupils in solving WPs. They concentrate on heuristics, metacognitive strategies, and visualisation (Verschaffel et al., 2020). For example, the use of visual representations like diagrams (Cooper et al., 2018) or bar models (Kho, 1987) has been shown to enhance spatial abilities, which are crucial for grasping the WPs' structure and converting them into mathematical models. Furthermore, Verschaffel et al. (2020) found that employing these strategies in interventions boosted pupils' ability to solve WPs. Therefore, we created a teaching intervention called the SIMPLE Approach based on existing literature on effective interventions to enhance WP-solving skills. This intervention is tailored for lower-secondary pupils and is rooted in socio-constructivism (Simon, 1995). Pupils get familiar with the bar model method (Kaur, 2018; Kho, 1987) and a series of problem-solving steps that support the development of their metacognitive skills (Verschaffel et al., 2020).

The success of any intervention is mainly dependent on its acceptance by the core actors, namely teachers who implement it in their lessons and pupils who receive it. Our work is embedded in design-based research consisting of three cycles led by three cooperating teachers. The paper focuses on the fidelity of teachers' implementation of the SIMPLE Approach, their perceptions of its applicability and effectiveness, and their confidence in its use. In this respect, our study aims to address the research gap in that intervention studies in design-based research recognise the critical role of teachers but provide little insight into their actual work and the fidelity of their implementation of the intervention.

2 Theoretical Background

WPs are important in mathematics classrooms because they show pupils how abstract mathematics can be applied to real-world contexts and enhance mathematical reasoning. Incorporating WPs into the classroom aligns with constructivist educational principles by promoting pupils' active engagement and exploration. By presenting realistic situations, WPs enhance pupils' interest in and motivation for learning mathematics, which Verschaffel et al. (2020) claim as crucial for developing higher-level cognitive skills. However, a wealth of literature shows that pupils do not always find WP solutions easily (e.g., Daroczy et al., 2015; Pearce et al., 2013; Verschaffel et al., 2020), and teachers sometimes struggle to present them adequately to the pupils (Pearce et al., 2013). Therefore, many researchers conducted interventions to understand the processes by which the ability to solve WPs is enhanced. The meta-analyses of studies (Hembree, 1992; Perry et al., 2018) found consistent results in that successful interventions include the development of pupils' metacognition and the use of visual representations.

2.1 Development of Metacognition

Metacognition is a higher-order thinking process needed for successful learning and problem-solving (Perry et al., 2018). It is also known as "thinking about thinking", "self-regulated learning", "thinking skills", and "learning to learn". The development of metacognition is embedded in WP interventions by introducing pupils to various scaffolding consisting of cognitive and metacognitive steps for solving WPs. For instance, Perry et al. (2018) found that interventions that provided structured prompts and step-by-step support helped pupils better understand problem structures and be more successful in selecting appropriate solution strategies. Similarly, Hembree (1992) highlighted that interventions incorporating explicit modelling and peer collaboration increased confidence and accuracy in solving WPs. An example of scaffolding used in such interventions is CRIME (Careful reading, Recall possible strategies, Implement possible strategies, Monitor, and Evaluation; Teong, 2003), SOLVE (Study the problem, Organize the facts, Line up a plan, Verify your plan with action, and Evaluate your answer; Freeman-Green et al., 2015) or STAR (Search the problem, Translate the words into an equation in a picture form, Answer the problem, and Review the solution; Özkubat et al., 2021).

Based on the above and other frameworks that divide solutions to WPs into steps and were shown to be beneficial for developing pupils' WP solving (Ho & Lowrie, 2014; Polya, 1957), the SIMPLE steps framework was developed for the study, comprising steps addressing factors that usually pose difficulties to pupils when solving WPs and facilitate the solution from the start to the end (Table 1). The acronym stands for "Study the problem", "Involve the bar model method", "Monitor the process", "Prepare/Present the solution", "Look over the solution again", and "Evaluate your answer".

Study the problem.	Read the problem and rephrase it. "Have I understood what I am supposed to find?"
Involve the Bar Model method.	Draw a diagram (create a visual representation of the word problem). How are the pieces of information in the word problem related? How can I represent these relations by rectangles?
Monitor the process.	Go back to the beginning, including the problem formulation. Ask yourself: "Is the bar model method helping me to understand how to reach the solution?" "Am I getting any closer to my objective?" "Am I still implementing the solving strategy I picked?"
Prepare/Present the solution.	Make the expression/calculation/equation, write the solution, and present it.
Look over the solution again.	Check the calculations and the answer.
Evaluate your answer.	Evaluate whether your solution makes sense and if there is a better way to solve the problem. Write up the answer.

Table 1: The SIMPLE steps

2.2 Visualisation in Word Problem Solving

Studies on WP teaching promote various types of visualisations. Some studies used prompts for pupils such as "organise information using a diagram", "draw a picture to tell what is happening", or "visualise the problem in a picture or diagram" (e.g., Pantziara et al., 2009), leaving it to the pupils to create a picture. In such a case, it was shown that when pupils use schematic drawings instead of pictorial ones, they are more successful in solving WPs (e.g., Boonen et al., 2014). Thus, learning a schematic representation may be more beneficial for pupils.

In our study, we used the bar model method. It is a schematic visual representation of the quantities given in a WP, which allows pupils to link the known and unknown quantities with the correct operation (Kho, 1987). There are three types of bar models: the part-whole model, the comparative model, and the change model (Kaur, 2018). The part-whole model describes the relationship between the whole and its constituent parts. In problem situations involving comparison models, a quantity is compared to another, showing how much one part is greater/smaller than the other. A change model depicts the relationship between a quantity's new value and after an increase or decrease its original value.

The bar model method makes it easier for pupils to break down and comprehend the relationship between elements of WPs. Through the visual representation of abstract numerical relationships, the bar model method facilitates pupil comprehension of complex concepts and allows them to organise their thoughts better, which is important for problem-solving. Singapore pupils regularly rank in the top three countries in mathematics, which may also be attributed to their successful adoption of the bar model method (Gani et al., 2019). Some evidence of the success of the bar model method usage has been accumulated over the years in other countries than Singapore. For example, in Türkiye, Baysal and Sevinc (2021) found that after pupils received instruction with the bar model method, they better understood the problem and could translate words into mathematical expressions with greater accuracy. Osman et al. (2018), in an intervention study with Malaysian pupils, revealed that implementing the bar model method in mathematics problem-solving led to pupils' better performance. Furthermore, studies show that the bar model method facilitates learning for pupils with learning difficulties (Ginsburg et al., 2005; Morin et al., 2017). Regarding Kosovo's context, two case studies with three 4th-grade pupils (Morina & Vondrová, 2021) and three 8th-grade pupils (Morina, 2023) reported positive impacts of the bar model method.

2.3 Social Constructivism

Finally, our intervention is embedded in the basic tenet of social constructivism (Simon, 1995), in which pupils are active participants in the learning process, and the teacher acts as a facilitator. It involves collaboration among pupils while solving WPs, as problem-solving in groups is a rich learning experience and was found to support WP-solving skills (Ventistas et al., 2024). Nevertheless, much research shows that teachers often find it difficult to implement constructivist instruction. One of the reasons is that they do not accept that they are not the primary source of education, and often, the class climate makes it difficult to comply with the constructivist philosophy (Windschitl, 2002).

2.4 Teacher's Role in Interventions

In our research, a teaching approach was developed based on the above key characteristics (socio-constructivism, the bar model, and the SIMPLE steps) and implemented in mathematics lessons. It is the teachers who are instrumental in successfully implementing and modifying educational strategies. They are not merely passive recipients of educational interventions created by researchers; rather, they play a vital role in adapting and shaping these interventions to suit their classroom contexts (Anderson & Shattuck, 2012).

In some intervention studies, teachers are provided with structured teaching plans that they are required to implement within their lessons. For instance, Altun et al. (2021) examined an intervention where teachers followed a research-based curriculum with structured teaching plans in a professional development programme and found that the plans facilitated adherence to the intended instructional approach and ensured fidelity in implementation. Conversely, some interventions incorporate teachers in the curriculum development process to guarantee alignment with their specific classroom contexts and pedagogical styles. Anderson and Shattuck (2012) stress the significance of such teacher-researcher collaboration in design-based research, emphasising that involving teachers in research ensures that interventions are crafted and refined in classroom environments. Similarly, Sterner (2019) argues that the participation of teachers in all phases of the design process is central to their learning. To sum up, the benefit of including teachers in curriculum development lies in increasing their engagement and confidence when applying novel methods, fostering a deeper understanding of instructional strategies and increasing the likelihood of sustainable implementation (Brown et al., 2020).

Ultimately, our literature review revealed that while intervention studies in design-based research recognise the critical role of teachers in applying the new curriculum for effective intervention, they offer limited insight into the actual work performed by these teachers, the fidelity of their implementation and their perception of the implemented way of teaching. Therefore, our study seeks to address this research gap.

2.5 National Context and Research Questions

The current Kosovo curriculum (MEST, 2016) aims to foster higher-order, critical and creative thinking, practical skills, and real-world competencies. It seeks to develop mathematics competencies that rely heavily on problem-solving, focusing on contextual problems and the use of technological means, the development of argumentation, reasoning, and representations. However, lower-secondary mathematics textbooks in Kosovo provide little opportunity to support pupils in developing problem-solving strategies and higher-order thinking skills, as most problems are routine and noncontextual (Berisha et al., 2013). The textbooks do not include visual representations of WPs, and teachers rarely use them when dealing with WPs in their lessons. Moreover, whole-class, teacher-led work still prevails in mathematics lessons in Kosovo even though the curriculum supports constructivist practices (Ismajli & Krasniqi, 2022). Thus, renegotiating the didactic contract (Brousseau, 1997) from teacher-led to pupil-centred and involving group work is necessary for implementing the intervention.

This study focuses on two research questions: How did the teachers' implementations align with the three characteristics of the SIMPLE Approach? What are the teachers' perceptions of the SIMPLE Approach, and how confident are they in adopting it in WP teaching?

3 Methodology

The study is part of a larger project that followed a design-based research methodology to integrate a constructivist teaching approach for WPs, called the SIMPLE Approach, in the context of Kosovo schools. The approach was developed to aid pupils in solving WPs by combining the bar model with metacognitive steps embedded in the basic tenet of constructivism. This challenging educational aim required an iterative, flexible, and context-sensitive research approach, which is offered by design-based research.

3.1 Design-Based Research and Implementation Fidelity

Design-based research is realised through iterative cycles and is vital for understanding how educational innovations work in classroom practice (DBRC, 2003). Interventions developed within design-based research often result in significant improvements after identifying and addressing challenges (Ford et al., 2017).

In design-based research, maintaining fidelity of implementation is essential. It refers to the extent to which an intervention is delivered as planned and conveyed to pupils based on the instructions given in a training session or a written guide (O'Donnell, 2008). High fidelity is all the more difficult to achieve in teacher-led interventions (as opposed to researcher-led interventions), as their commitment and adaptability greatly influence their success. Thus, intervention studies involve the phase of teacher training. Since the teachers were not involved in developing the SIMPLE Approach, the decision we made at the beginning, as teachers in Kosovo were unfamiliar with the bar model method and were less proficient in teaching word problems, it was vital to ensure they adhered closely to the intended implementation. The teachers were introduced to the SIMPLE Approach during an initial session and received structured teaching plans for each lesson.

There is usually a difference between intervention-as-designed and intervention-as-implemented (Nelson et al., 2012) as while strict adherence to the original design of an intervention is important, teachers need to adapt their teaching to factors such as concrete class and pupils' needs, classroom dynamics, the availability of resources, pupils' misbehaviour (Combs et al., 2022), etc. Studies use various fidelity implementation instruments to capture whether such adaptations did not stray from the core components of the intervention (Carroll et al., 2007). For example, Clements et al. (2011) developed an instrument with 52 items (such as "The teacher conducted the activity as written in the curriculum or made positive adaptations to it (not changes that violated the spirit of the core mathematical activity)", p. 137) in which observers assessed the implemented teaching on 5-point Lickert scales. Their intervention was implemented by 106 teachers, and the trained observers collected fidelity data twice in all classrooms. Our study had only one observer, and the number of lessons observed was small. Thus, our fidelity instrument was far more open. Based on the literature (Century et al., 2010; Crawford et al., 2012), it targeted the three core design aspects of the SIMPLE Approach: Adherence to the Guide, Adapting constructivist principles, Pupil engagement, and Adaptation and flexibility.

3.2 Participants

Three cycles of the intervention were conducted with three 8th-grade classes in three schools. All schools were located in the city of Gjilan, in the first author's vicinity. The teacher and the school choice were based on the teachers' willingness to participate in the study, and the class choice was based on the

teacher's teaching plan for the class (whether WPs fitted it) and the schedule (to be able to observe all the lessons). The first cycle intervention was taught by a male teacher (Teacher 1) with 25 years of experience teaching mathematics. The second and the third were female teachers with 20 years of experience and 12, respectively, teaching mathematics (Teacher 2, Teacher 3).

In the Pre-Implementation phase, the researcher introduced the teachers to the bar model method and the SIMPLE steps during an initial one-hour session and answered any questions they had. Next, they received the Teacher Guide. It first presents the bar models, their types, and some WPs solved by bar models. The SIMPLE steps are then explained, along with their indicators, significance, and application in some WPs' solution processes. In addition, the Guide describes a constructivist approach to teaching, emphasising principles that promote pupils' active involvement, problem-solving, and reflection through group work and discussions.

3.3 Description of the SIMPLE Approach and its Intended Implementation

As already stated, the SIMPLE Approach is embedded in the principles of constructivism. Constructivist teaching focuses on pupils' learning by encouraging them to explore, ask questions, and construct their understanding through interactions with the teacher and their peers. This approach is intended to promote a deeper comprehension of WPs, too. The SIMPLE Approach encourages pupils to reflect on their problem-solving processes, organise their solutions, monitor the process, and evaluate their answers, which is an important aspect of cognitive development.

Teachers are critical in implementing the constructivist teaching approach in our study as they guide pupils through the learning process (Simon, 1995). Consistent with constructivist principles, the Teacher Guide and the initial session with the teachers promote pupils' active involvement and reflection through group work and discussions (Mcnamara et al., 2002). To support the learning of the SIMPLE Approach in the lessons, the teacher is responsible for outlining the basic concepts of each lesson plan, guiding pupil practice, holding discussions, setting up individual and group work, encouraging cooperation before moving on to individual practice, and letting pupils construct their knowledge while working through WPs. Teachers should encourage pupils to ask questions at all times, develop discussion in class, and create a friendly environment so that pupils feel they have the necessary support to succeed.

One of the major findings in Hembree's (1992) meta-analysis of studies was that instruction in diagram drawing and translation from words to mathematics offers large effects toward better pupils' performance and that explicit training appears essential. He further warns that simultaneous training in multiple skills (such as handling extraneous data, mathematics vocabulary, mathematics reading, guess-and-test, etc.) appears less effective than training in a single skill. Taking the above and a short time frame into account, we decided to provide explicit instruction for the bar model method, which is considered one step in a specific scaffolding (called SIMPLE steps) as the core characteristic of our approach.

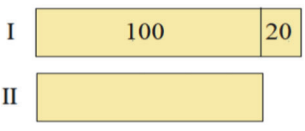
The next two sections depict how the teacher in Cycle 1 was supposed to implement the SIMPLE Approach. Depending on the observations and other data gathered, this was slightly changed in the following cycles.

3.3.1 Bar Model Method

As the bar model method was to be used with Kosovo pupils with no experience with visual representations for solving WPs, they were to be introduced to the three basic types of bar models on examples of several WPs and then practise making such models for some more WPs.

In the first lesson, the teacher should introduce pupils to three types of bars, using simple examples to clarify their application to different types of WPs. The teacher should draw all the types of bar models on the blackboard and ask pupils to take notes to help them recognise and understand how their structure is connected with different WPs. After that, discussions about the bar model application should be encouraged to help pupils address misconceptions. Following the introduction, the teacher should present and explain the solution of WP1 to the pupils, ensuring they understand the process step by step (Fig. 1). On purpose, the problem is easy to comprehend, but it includes inconsistent language. The use of bar models helps pupils realise that subtraction rather than addition is needed for the solution.

WP1. There were 120 visitors to Clara's art exhibition on the first day, which is 20 more than on the second day. How many visitors came to the exhibition on the two days?



$$I:\ 120$$

$$II:\ x = 120 - 20 = 100$$

$$T = I + II = 120 + 100 = 220$$

Fig. 1: One of the WPs used to introduce pupils to the bar models, with a correct solution

Next, the teacher should guide pupils through solving another WP, emphasising the application of the bar models. Pupils should be encouraged to work independently or in groups, with the teacher facilitating discussions and addressing questions as needed. The focus remains on reinforcing the correct use of the bar model method.

In the second lesson, pupils should practise four more WPs. Discussions about applying the bar model and the pupils' problems need to be encouraged to help pupils reflect on their learning. Again, pupils should be encouraged to work alone and in groups to foster individual and group learning.

3.3.2 SIMPLE Steps

The teacher should introduce the SIMPLE steps and explain their benefits in solving WPs in two lessons. The first of them (the third lesson of the intervention) should start by explaining the meaning of each letter and demonstrating how to execute each step by thinking aloud while solving one WP and letting pupils apply the same process to the second WP. Table 2 exemplifies how the SIMPLE steps can be applied within the solution for WP3 and WP4. The statements in Table 2 are hypothetical, not actual quotes by the teacher, but a way to treat the solution. The teacher should initiate discussion and ask questions after each step applied.

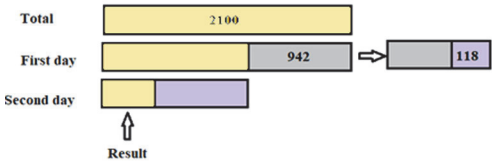
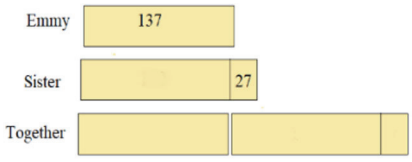
	WP3: Of the 2 100 kilograms of potatoes in the warehouse, 942 kilograms were sold on the first day, while on the second day, 118 kilograms less than on the first day. How many kilograms of potatoes are left in the warehouse?	**WP4:** Emmy collected 137 stamps, which is 27 stamps fewer than her sister. How many stamps did they collect together?
S	*I have to find the kilograms of potatoes that are still unsold after two days. We know the number of potatoes sold on the first day; we need to find it for the second day and then those left.*	*I have to find the number of stamps collected by Emmy and her sister, knowing the number of stamps collected by Emmy and the difference between Emmy's number of stamps and that of her sister.*
I	*So, I will draw bars showing the kilograms of potatoes left after being sold on the first day. Then, another bar for those sold on the second day, and the third one for those still unsold.*  	*I will draw the bar showing Emmy's stamps first and then add another bar for her sister which should be longer. And the third will represent the total.* 
M	*Yes, I think I am on the right path and getting closer to the objective since now I know what and how much I must subtract to find the final answer.*	*I think the bar model method is helping me to come to the solution because, based on the bars, I understand that Emmy's sister has 27 more stamps than Emmy.*
P	*First, we subtract the total number of kilograms sold on the first day. The number of kilograms sold on the second day is determined by subtracting 118 from the first day's total. After that, we also eliminate the ones from the second day, which leads us to the solution.* Day I: $2\,100 - 942 = 1\,158$ Day II: $1\,158 - (942 - 118) = 1\,158 - 824$ Left $= 334$	*Le x be the number of stamps that Emmy's sister has.* $\begin{aligned} \text{Emmy} &\rightarrow 137 \\ x - 27 &= 137 \\ x &= 164 \end{aligned}$ Together $\rightarrow 137 + 164 = 301$
L	$\begin{aligned} 334 + 824 + 942 &= 2\,100 \\ (\text{left} + \text{secondday} + \text{firstday}) &= \text{total} \end{aligned}$	$\begin{aligned} 137 + 27 &= 164 \\ 301 - 137 &= 164 \end{aligned}$
E	*The final answer is 334, which makes sense since we arrived at the warehouse's total kilograms of potatoes by working backward.*	*The result makes sense. We found the number of stamps Emmy's sister had by working backward.*

Table 2: Example of WPs solved with the SIMPLE steps

The fourth intervention lesson should start by assigning the pupils four WPs and asking them to work individually, then in pairs and groups, using both the bar model and SIMPLE steps in the solution. The teacher must ensure pupils can name, explain, and list each step.

3.4 Data Collection

The study focuses on selected data gathered in three stages of the study. Namely, the "Pre-Implementation stage", which includes an initial session with teachers, the "Implementation stage", which includes data from the observation of four lessons on the first cycle and five intervention lessons on the second and third cycles, and teacher diaries, and the "Post-Implementation stage", which includes interviews with teachers regarding their perception of the SIMPLE Approach.

Interviews. A semi-structured interview was used because it allows for flexibility in the interview process. This type allowed us to prepare specific questions in advance while remaining open to teachers' thoughts and beliefs about the SIMPLE Approach. The teacher interviews were conducted after the end of each cycle and lasted around 20–30 minutes, depending on the teacher's responses. Informal discussions were held with the teachers before and after lessons to gather immediate feedback. While these informal chats were not structured, they provided valuable insights into the teachers' perspectives. The chats were captured in the researcher's notes.

All the interviews were conducted by the first author. With the participants' agreement, the interviews were audio-recorded to capture their comments accurately. Audio recordings capture participants' exact words, tones, and pauses, which is crucial for understanding context and meaning and for the reliability of the analysis (Rutakumwa et al., 2020). Notes were taken during the interviews to document nonverbal cues and contextual information.

Observations. The observation method involves the researcher's presence in the setting of the subject of the research and collecting data from what they see. The researcher may observe as an insider by playing an active role in the ongoing event or as an outsider by having a passive role in the event (Creswell et al., 2007). Observation allows researchers to collect more data (e.g., through writing field notes). On the other hand, the method is criticised for being less informative about the potential motivation for the participants' behaviour in action.

In this study, the observer had a passive role in observations. The lessons were observed by the first author without interfering and were audio-recorded. Her main goal was to discern situations in which the implementation fidelity or its breach was apparent. These aspects were followed during the lessons:

- Adherence to the Guide: Observing whether the teacher followed the instructions given in the Teacher Guide regarding the core design characteristics of the intervention (the SIMPLE steps, bar models).
- Adherence to the constructivist principles: Evaluating how well the teacher presented the materials and engaged pupils during the lessons, ensuring that constructivist principles were applied.
- Pupil engagement: Monitoring pupil participation and interaction during lessons to evaluate if the approach facilitated active learning as intended.
- Adaptation and flexibility: Noting any modifications the teacher made while presenting the SIMPLE Approach and considering them for further refinement of the intervention.

This information was collected both onsite while observing in the form of field notes and later when replaying the audio recordings of the lessons.

Field notes. Field notes refer to the details that occur while observing specific events being studied (Creswell et al., 2007). They allow researchers to collect data that can be captured with eyes but cannot be recorded. In this study, field notes were made from teachers' initial sessions before the intervention and their actions during the implementation of the lessons.

Teacher diary. Teacher diaries are useful tools in education because they allow participants to record information in written or spoken form about themselves, their actions, or their thoughts (Arndt & Rose, 2023). Although teacher diaries were originally perceived as a means of reflective practices in teacher education, they can be used for many forms of data analysis and are, therefore, useful as research tools in education research (Yi, 2008). In our study, teacher diaries were used to obtain their reflections on the mathematics lessons they taught during the intervention. The teachers were asked to write the diary immediately following each lesson so that their reflections were current. They were instructed to start by presenting the lesson, describing how it went, and offering recommendations or new ideas for future lesson implementation.

3.5 Data Analysis

For the study, the interviews, observation field notes, and teacher diaries were transcribed and translated from Albanian to English.

First, the audio-recording of lessons and interviews were transcribed and all the data were divided into three stages of the study. The Pre-Implementation stage comprises the researcher's field notes from the initial session and informal chats with the teachers before the intervention. The Implementation stage involves transcripts of audio recordings of lessons, field notes, and teacher diaries. Finally, the Post-Implementation stage involves transcripts of interviews with teachers and field notes.

Next, in all the data, we identified units (parts of the transcripts of interviews, of the researcher's field notes and teacher diaries) in which the teacher's views and implementation fidelity were visible, focusing on the categories stemming from our research questions and study of literature (Table 3).

Stage	Categories
Pre-implementation	Initial perception of the SIMPLE Approach
	Initial beliefs about the effectiveness of the Approach
	Confidence in implementing the Approach in the class
Implementation	Adherence to the Guide
	Adherence to the constructivist principles
	Adaptation and flexibility
Post-Implementation	Evaluating SIMPLE Approach lesson success and confidence in its implementation
	Opinions on the usability and impact of the Approach on pupil learning
	Identifying areas for improvement in the Approach

Table 3: Framework for analysing data

The unit of analysis in each episode was a meaningful unit which could be categorised by one category. There were cases, where the category was divided into subcategories, such as, "Adherence to the Guide" was divided into "Bar model representation" (whether the types of bars were distinctly identified and accurately utilised), and "SIMPLE steps implementation" (how each of the SIMPLE steps was introduced and applied in WPs). "Adherence to the constructivist principles" included "Collaborative learning" (whether and how the teacher organised group work and facilitated discussions among peers), and "Classroom discourse" (how discussions were managed and how pupils were encouraged to inquire).

For example, the following excerpts from the teacher diary were categorised as "Opinions on the usability and impact of the Approach on pupil learning". Teacher 1 stated, "The bar model method was very interesting. Pupils liked it, but I think they need more time for practice to understand fully." Similarly, Teacher 3 stated, "The lesson went wonderful, as pupils quickly adapted to it. I noticed that even pupils who previously were not interested in mathematics began to show interest and engage in the solution of WPs."

4 Results

The findings related to our two research questions are structured according to three phases (Pre-Implementation, Implementation, and Post-Implementation). The Implementation phase is divided into three cycles, as the first (second, respectively) cycle influenced the implementation of the intervention in the second (third, respectively) cycle. The findings in the following sections contribute to answering two research questions, which will be revisited in the Discussion section.

4.1 Pre-Implementation Stage

Table 4 summarises the teachers' initial understanding of the SIMPLE Approach, their beliefs and confidence in its future use as determined from the initial session and informal chats before teaching. Teacher 1 was initially sceptic about including the bar model method in the solution of the WPs due to its novelty for both him and the pupils but became more receptive after detailed guidance by the first author in the initial session and seeing the support provided by the Teacher Guide. Teacher 2 and Teacher 3 found the intervention promising from the start. They believed it would arouse pupils' curiosity and help them stay focused through visualisation, which was, according to them, missing in existing textbooks.

4.2 Implementation Stage (inconsistency)

Throughout the three cycles, despite using the same Teacher Guide, differences were observed in how the teachers implemented the lessons.

4.2.1 Teacher 1

Teacher 1 introduced bar model types orally without visually illustrating them on the blackboard, which did not fully align with the Guide. In the practice stage, he drew the correct bar models for the pupils but did not explain which type of bar model was used. For example, for WP1, he drew a bar model for

Category	Teacher 1	Teacher 2	Teacher 3
Initial perception of the SIMPLE Approach	Initially, Teacher 1 was sceptic about including the bar model method in the solution of the WPs and did not see the benefits of using group work.	Teacher 2 liked and agreed with all characteristics of the intervention.	Teacher 3 felt satisfied with all characteristics of the SIMPLE Approach.
Initial beliefs about the effectiveness of the Approach	Teacher 1 believed the step-by-step instructions would help provide a more accurate WP solution.	Teacher 2 showed strong belief in the success of this approach to teaching WPs.	Teacher 3 believed this approach would arouse pupils' curiosity and help them stay focused.
Confidence in implementing the Approach in the class	Teacher 1 expressed confidence and willingness to include all three characteristics of the SIMPLE Approach in his teaching.	Teacher 2 was convinced that implementing the proposed approach would not be difficult for her.	Teacher 3 expressed confidence that her usual teaching style complies with the constructivist principles outlined in the Guide.

Table 4: Teachers' understanding, beliefs and confidence in the Pre-Implementation stage

the total number of visitors to exhibit on the first day (120), then for the second day sold (100) and then for a total of two days (220). Still, even though the drawing was there, the teacher failed to inform pupils which bar model type was associated with his drawing. He should have emphasised that the comparative model was applied to the solution based on the instructions given in the Guide.

In two lessons, the teacher assigned pupils six WPs to practise the bar model method. He closely monitored the pupils and stepped in when they struggled by asking questions regarding the type of bars in each WP solution or sometimes helping with their drawing. He preferred individual and paired work over group activities as, based on his statement in the bar model lesson (second lesson), "pupils will misuse the situation and make unnecessary noise in the classroom".

In the third lesson, Teacher 1 introduced the SIMPLE steps to WP3; he clearly distinguished each step and explained their importance. To reinforce understanding, he gave the pupils WP4 and asked them to solve it by working in pairs with a friend sitting next to them. Most pupils successfully solved the problem (refer to the example in Fig. 2), and one of them shared the solution on the blackboard. The pupil started by paraphrasing the problem by writing, "Emmy has collected 137 steps, which is 27 fewer than her sister. We need to find those collected by both." Then, the pupil drew the bar models and prepared the solution by writing the unknown quantities: "Let x be the number of stamps that Emmy has, $x + 27$ the number of Emmy's sister's steps. We add them together." The pupil then presented the solution and looked into the solution again but neglected the evaluation of the problem in which they should have reflected on the solution, discussed different possible methods, and considered the reasoning behind their answers. Teacher 1 did not encourage them to do so.

In general, our observations showed that Teacher 1 did not fully follow the constructivist principles. Unlike the Guide's instruction, he did not initiate discussion or group work during the lessons, leaving

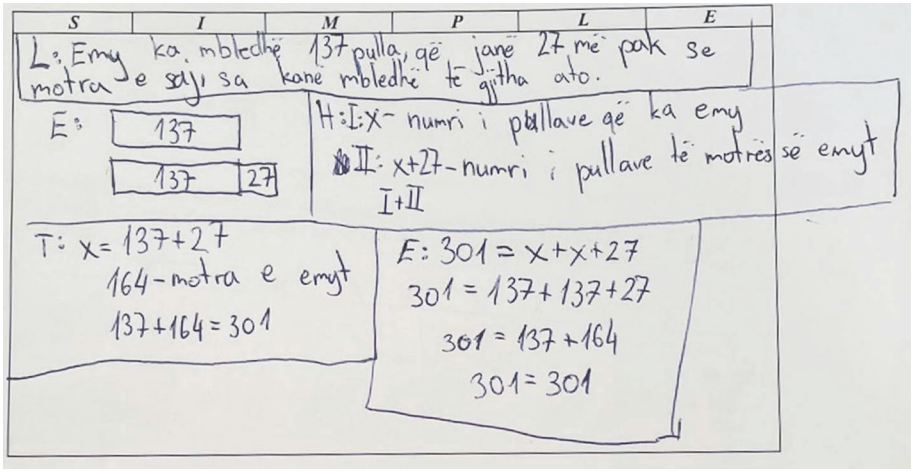


Fig. 2: The solution of WP4 using the SIMPLE steps (LEHTE is the Albanian equivalent for SIMPLE)

pupils to work mostly individually or in pairs. There were instances where, when a pupil asked if their solution was right, the teacher indicated that it was wrong but failed to associate that mistake with the pupil's drawing and explained it by pointing to the solution via an algebraic equation. Sometimes, the teacher felt unsure how to proceed with the lessons and asked the observer (the first author) to help explain certain aspects of the SIMPLE Approach to the pupils. Regarding pupil engagement, the teacher mentioned that there was "good engagement, interest and comprehension" during SIMPLE Approach lessons.

4.2.2 Teacher 2

Based on the results of the observation of the first cycle, Teacher 2 was reminded in the initial session to adhere more closely to the Guide's instructions, particularly in presenting the bar model types. Second, an additional lesson for the bar models practice was included to help pupils understand them better before proceeding to the SIMPLE steps. Third, the adherence to the principle of incorporating group work, as suggested in the Guide, was emphasised to Teacher 2.

Teacher 2 started by introducing the bar model types and visually demonstrating them, using examples and encouraging class discussions. She dedicated all 45 minutes of the first lesson to explaining the bar model types and discussing their usage with pupils. In the following two lessons, she demonstrated its use in WP1 and gave pupils five other WPs to solve independently. In two other lessons, she introduced the SIMPLE steps by solving WP3 on the blackboard and letting pupils practise it in other WPs. She incorporated the pupils into the process by asking questions continuously. For example, for the first step, "S", she asked pupils to rephrase the problem in a way they understood. It was noticed that the teacher's focus was not the same for all the SIMPLE steps. Steps like "Evaluating your answer" or "Monitoring the process" received less attention. For example, Teacher 2 commented on the former step by merely saying, "Based on the result and the proof, the solution is correct", without initiating a discussion with the pupils.

The pupils could decide whether to work alone or with friends while practising solving other WPs. The teacher observed the process and intervened by helping them when they struggled with continuing the solution steps. However, based on our observations, pupils found it challenging to implement all the SIMPLE steps for each of the four assigned WPs due to the approximately 30 minutes of remaining time during that lesson.

Similarly to Teacher 1, Teacher 2 did not implement group work as suggested in the Guide, allowing pupils to work alone or in pairs. While Teacher 2 followed the Guide more closely than Teacher 1, she did not give equal attention to all the SIMPLE steps, especially those involving evaluation, as mentioned above. Despite such deviations, Teacher 2 showed dedication to the approach. During informal chats in the lessons with the first author, she mentioned that she had even started applying it in classes in other grades. Regarding the pupils' engagement, she mentioned that "pupils were quite interested in using visualisation", and she noticed an increased interest in solving the WPs given with SIMPLE steps.

4.2.3 Teacher 3

The results of the second cycle allowed us to refine the intervention for the third cycle. First, similar to the second cycle, we continued with the additional lesson on the bar model practice. Second, it was stressed to Teacher 3 to adhere more closely to the Guide's instructions, particularly on the presentation of the bar model types and initiating group work. Third, Teacher 3 was asked to give the same emphasis to all the SIMPLE steps based on the guidelines in the Guide.

Teacher 3 began the lesson by explaining the bar model method types, drawing them on the blackboard, and taking simple examples with some elements from the classroom (books, pens and chalks) to clarify which problem each type of bar model belongs to (for example, "I have three pens, two more than Ema has; how many pens are there?"). This was something she added on top of what the Guide suggested.

In the next lesson, she recalled what they had learned in the previous lesson by asking questions and developing a discussion. After that, the class practised the bar model method in some WPs. Pupils first started to work on the solution individually. The teacher sometimes provided help in drawing the bar model, but when she saw progress, she stepped aside and let the pupils work alone. After 10 minutes, she formed group work, fostering both independent and group learning. The same procedure was repeated in other intervention lessons. Teacher 3's classroom was very interactive, with many opportunities opened by the teacher to pupils to ask questions and discuss their work. Rare moments were observed when Teacher 3 could not give the necessary feedback due to the short time. Although she managed most pupils' questions, time constraints sometimes limited her feedback. Her adherence to the Guide was consistent, and each lesson was delivered as planned.

It was also noted that the teacher wanted to provide this approach to other pupils. She invited three 9th-grade pupils to participate in the bar model and SIMPLE steps lessons, stating that this approach would help them prepare for mathematics competitions. Similar to Teacher 1 and Teacher 2 regarding pupil engagement, Teacher 3 stated that "even those pupils who were usually not active in mathematics lessons started to show great interest in solving the WPs".

4.3 Post-Implementation Stage

Table 5 presents some quotes from the interviews and statements from diaries[1] related to the three categories followed in the data. In general, the three teachers had positive attitudes towards the SIMPLE Approach after the implementation of the intervention. They appreciated it and felt that pupil involvement and accuracy in solving WPs increased. Nevertheless, their perspectives differed.

Question theme	**Teacher 1**	**Teacher 2**	**Teacher 3**
Evaluating SIMPLE Approach lesson success and confidence in its implementation	"As this method is new to the pupils and me, it was challenging to present and practise the bar model method in two lessons. We had just learned to solve word problems by converting them into equations, and although quite attractive, this method seemed a little difficult for the pupils to understand at first." *This approach is very good and easy to use, and I would like to incorporate it in future teaching lessons.*	"I liked it. After I did the intervention here, I also explained it to the 7th-grade class. We used it in some simple WPs, which helped them easily find a solution." *I will continue using the SIMPLE Approach in the future with all grades, not only the 8^{th} ones.*	"I appreciate this approach and did not find it difficult to present as I explained it step by step." "I think that even the pupils grasped them quickly." *I will use the approach frequently, and I hope it will also be included in mathematics textbooks.*
Opinions on the usability and impact of the Approach on pupil learning	"I observed a heightened level of engagement among pupils who were previously less active in other mathematics classes." "The pupils responded well to the SIMPLE Approach, which grabbed their curiosity and increased their accuracy on word problems." "In the beginning, they [the pupils] had difficulties understanding and using it, but I think they did it well after some practice."	"I have noticed that this approach affects me as a teacher, besides increasing pupils' engagement and helping pupils solve word problems. Honestly, it never occurred to me to use bars to solve problems, but I liked them."	"I would like this approach to be included in textbooks or literature on mathematics. I believe that pupils would benefit greatly from it. This approach is also attractive as drawing bar models increases pupils' curiosity. Even pupils not interested in mathematics began to show interest and engage in these lessons."
Identifying areas for improvement in the Approach	"I suggest more time to practice further, as it [SIMPLE] has more steps and requires more time to explain all of them specifically." *In order for pupils to master it, I think they need more time to practise and feel comfortable with it.*	"In my opinion, the 'evaluating the solution step' is not always necessary to put it in writing due to the limited time of 45 minutes." *My only suggestion is that we do not need to ask pupils to write everything on paper if they are sure how to do it.*	"Every step plays an important role in the solution and I would not change any part. Combining the bar model method with other steps improved learning." *I will not change anything.*

Table 5: Selected quotes from the teachers' interviews and diaries

[1]The fragments in italics presented in Table 5 are taken from teacher diaries while those in quotation marks from interviews.

Teacher 1's interview and diary provided complementary information to what was directly observed during the lessons and, to some extent, explained some events. According to his diary, the pupils quickly grasped the BM method, making correct drawings and achieving correct solutions to WPs. However, this was in contrast to the observations during the lessons and the interview (see Table 5, the first line for Teacher 1). The teacher emphasised the need to prolong the intervention, suggesting that a more extended implementation time would improve understanding and effectiveness.

Teacher 2 and Teacher 3 showed high motivation and willingness to learn and convey the approach to the pupils. They appreciated it since, during the interview and according to their diary data, they reported that they had started incorporating it with pupils in other classes, too. They were confident in its long-term use and said they would like to include this approach in elementary school mathematics textbooks.

5 Discussion and Implications

5.1 Teachers' Alignment with the Three Characteristics of the SIMPLE Approach

Our first research question focuses on the fidelity of teachers' implementation of the three characteristics of the SIMPLE Approach, namely how they presented the bar model method and the SIMPLE steps to the pupils and complied with the approach's constructivist underpinning. In general, the fidelity was very high in Teacher 3's teaching, high in Teacher 2's class, and the least in Teacher 1's class.

Using the observations of lessons, interviews with teachers and the teacher diary, we identified differences between the intervention-as-implemented and the intervention-as-designed (Nelson et al., 2012):

- Introducing bar model types without visual illustrations (Teacher 1)
- Failing to associate bar model types with the inner structure of the WP (Teacher 1)
- Missing opportunities to initiate discussions and explore pupils' misunderstandings (Teacher 1)
- Failing to use visual representations to help pupils solve the problem and resorting to algebra instead (Teacher 1)
- Using little group work (Teacher 1, Teacher 2)
- Failing to give the same emphasis to all SIMPLE steps (Teacher 2)
- Introducing pupils to the types of bar models by using three simple WPs with objects in the classroom (Teacher 3).

Overall, there is a gradual improvement among the cycles both in terms of the content (bar models, SIMPLE steps) and approach (based on constructivist principles). One cause of this lies in the repetitive nature of our study with the changes made after the first and second cycles. These results support Ford et al.'s (2017) claim that interventions often result in significant improvements after identifying and addressing the first-cycle challenges.

Nevertheless, the success of any teaching depends on many contextual factors, the most important ones being the class and the teacher. The three classes were of a similar size and composition and we did not witness any observable differences (such as behaviour problems) which could have impacted the success of the intervention. The teachers had similar experience with teaching WPs, used the same textbooks and had no experience with using visualisation when solving WPs. They expressed the same willingness to master a new approach and adapt their teaching to it. Yet, we identified some differences which impacted the intervention.

First, the mastering of strategies to be taught is paramount.[2] In the present study, this was evident, especially for Teacher 1 as there were situations in which, after being asked by the pupils if the solution was correct, he failed to associate it with their drawing and went back to their usual way of solving WPs by pointing to the solution via an algebraic equation. It can be inferred that this preference stems from his long-standing reliance on linear equations in teaching WPs, which made a shift to the SIMPLE Approach challenging. Teacher 1 would have benefited from a longer initial training or his inclusion in all phases of the design process. This is in accordance with Sterner (2019) and Brown et al. (2020), who argue that the participation of teachers in all phases of the design process fosters a deeper understanding of instructional strategies and increases the likelihood of sustainable implementation. Nevertheless, it must be stressed that Teacher 1 did not seem hesitant about the content before the intervention. It only became apparent during his teaching. No problems with mastering the bar model method were observed for the other two

[2]For example, Hembree (1992) in his metaanalysis of studies uncovered a clear impact on pupil performance resulting from teachers especially trained in heuristics (which they were to develop in their pupils).

teachers. Teacher 2 did not seem to value the importance of some steps of a metacognitive nature in the scaffolding provided (SIMPLE steps) and would require some attention to this feature.

Second, the three teachers differed in their usual teaching style and how "constructivist" it was. While Teacher 1 did not want to use pair or group work at all (as he stated), Teacher 2 and especially Teacher 3 welcomed it as they used it in their usual teaching. In the cycles when the group work was present, it was observed that it supported the solution of WPs through the SIMPLE Approach as pupils often relied on each other and collaborated when encountering difficulties during the WPs solutions. These findings complement statements made by Ventistas et al. (2024), who demonstrated that problem-solving in groups is a rich learning experience that supports WP-solving skills. By supporting group work, the teacher's role moved from being the primary source of knowledge to that of a learning facilitator who supports and challenges pupils to construct their understanding (Mcnamara et al., 2002; Simon, 1995). Thus, Teacher 1 and his class had "the longest way to travel" to implement the intervention faithfully to the principles of pupil active learning. Adopting constructivist teaching approaches frequently presents initial obstacles for teachers. With time and experience, teachers adjust to and value the new learning and teaching approach (Windschitl, 2002). The question remains as to what extent it is reasonable to expect such a development in the case of the teachers in the present study, as this was a one-time intervention.

5.2 Teachers' Perceptions of the SIMPLE Approach and Their Confidence in Adopting it in WP Teaching and Solving

The three teachers had positive attitudes towards the SIMPLE Approach from the beginning and appreciated its benefits at the end of the intervention. They all expressed their perception of pupils' more active engagement in the lessons and belief that the new ways of solving WPs helped the pupils to be more successful.

The Approach was new to the pupils, and Teacher 1 warned that conveying it to them in such a short timeframe was not easy. This probably mirrored his own insecurities in using the new strategies (especially the bar model method) mentioned above and resulted in lower confidence in utilising the SIMPLE Approach. In contrast, Teacher 2 and Teacher 3 exhibited greater confidence, as evidenced by their initiation of the new approach with pupils even outside the intervention classes. They expressed conviction in the continued application of the new approach and indicated a desire to see it incorporated into mathematics textbooks.

5.3 Implications

To master a new approach, there is a need for comprehensive training and ongoing support for teachers to build confidence and avoid reliance on familiar but less effective strategies. Our data confirm the necessity of thorough training before the intervention (Carroll et al., 2007). This is all the more true if the new approach requires a major change from teacher-centred teaching to pupil-centred one (Windschitl, 2002), which necessitates the adjustment of not only the teacher's teaching style but also how pupils engage in lessons. Thus, the length of the intervention should also be considered.

Our findings have implications for education in contexts where visual representation and metacognitive strategies are not widely emphasised, as they suggest that the SIMPLE Approach can be successfully adapted to such environments. While we aimed to evaluate a short-term intervention described in this paper, the future use of the SIMPLE Approach should be considered as part of mathematics lessons in all grades and would require detailed planning for each to cater for the specific context of Kosovo. One recommendation would be to ensure the teacher's participation in all the phases of a design process which is central to their learning (Sterner, 2019) and mastering the new approach. Challenges that the teachers encounter in the classroom provide opportunities to continue the design process and lead to changes in the intervention that can help teachers in their teaching.

6 Limitations and Conclusions

Our findings must be considered within the limitations of the study.

First, even though the new teaching approach was evaluated positively by the teachers, these findings cannot be generalised. The sample is small, limited to one school grade and three classes from one city.

Second, the teacher's role in our study was shaped by their initial unfamiliarity with the bar model method, which influenced their ability to engage with the intervention from the outset. Unlike some design-based research frameworks where teachers are co-designers, the novelty of the bar model method would have necessitated a more guided approach at least for one of the teachers.

Third, a limitation of our study is that the teachers' regular teaching before the intervention was not observed, and reliance was only placed on their descriptions. Without this baseline observation, it is difficult to determine if the teachers' adherence or non-adherence to constructivist principles during the intervention directly resulted from their typical teaching style or was impacted by the intervention itself.

Despite the limitations above, we believe that by framing this research as a local instruction theory development, our study provides a valuable framework for future educational interventions to improve WP-solving skills in diverse classroom settings. In short, when interventions are developed by researchers and executed by teachers who are not part of their design process, it poses a challenge to their intended effective implementation. This situation can result in reduced fidelity to the new approach, a reversion to their usual teaching methods, gaps in comprehension and low confidence in its usage. Thus, for an intervention to be effectively implemented, it is recommended that teachers be more actively involved in its design and be supported through continuous monitoring and adaptation.

Acknowledgment

This study is an outcome of the project 'The impact of the SIMPLE strategy on enhancing the ability to solve word problems with 8th graders' (Project No. 166823), supported by the Charles University Grant Agency (GAUK).

References

Altun, S., Yabaş, D., & Bal-Nayman, H. (2021). Teachers' experiences on instructional design-based professional development: A narrative inquiry. *International Electronic Journal of Elementary Education*, *14*(1), 35–50. https://doi.org/10.26822/iejee.2021.227

Anderson, T., & Shattuck, J. (2012). Design-based research: A decade of progress in education research? *Educational Researcher*, *41*(1), 16–25. https://doi.org/10.3102/0013189X11428813

Arndt, H., & Rose, H. (2023). Capturing life as it is truly lived? Improving diary data in educational research. *International Journal of Research & Method in Education*, *46*(2), 175–186. https://doi.org/10.1080/1743727X.2022.2094360

Baysal, E., & Sevinc, S. (2021). The role of the Singapore bar model in reducing students' errors on algebra word problems. *International Journal of Mathematical Education in Science and Technology*, *53*(2), 289–310. https://doi.org/10.1080/0020739X.2021.1944683

Berisha, V., Thaçi, X., Jashari, H., & Klinaku, S. (2013). Assessment of mathematics textbooks' potential in terms of students' motivation and comprehension. *Journal of Education and Practice*, *4*(28), 33–37.

Boonen, A. J. H., Van Wesel, F., Jolles, J., & Van der Schoot, M. (2014). The role of visual representation type, spatial ability, and reading comprehension in word problem solving: An item-level analysis in elementary school children. *International Journal of Educational Research*, *68*, 15–26. https://doi.org/10.1016/j.ijer.2014.08.001

Brousseau, G. (1997). *Theory of the Didactical Situations in Mathematics*. Kluwer Academic Publishers. https://doi.org/10.1007/0-306-47211-2

Brown, B., Friesen, S., Beck, J., & Roberts, V. (2020). Supporting new teachers as designers of learning. *Education Sciences*, *10*(8), 207. https://doi.org/10.3390/educsci10080207

Carroll, C., Patterson, M., Wood, S., Booth, A., Rick, J., & Balain, S. (2007). A conceptual framework for implementation fidelity. *Implementation Science*, *2*(1), Nu. 40. https://doi.org/10.1186/1748-5908-2-40

Century, J., Rudnick, M., & Freeman, C. (2010). A framework for measuring fidelity of implementation: A foundation for shared language and accumulation of knowledge. *American Journal of Evaluation*, *31*(2), 199–218.

Clements, D. H., Sarama, J., Spitler, M. E., Lange, A. A., & Wolfe, C. B. (2011). Mathematics learned by young children in an intervention based on learning trajectories: A large-scale cluster randomised trial. *Journal for Research in Mathematics Education*, *42*(2), 127–166.

Combs, K. M., Buckley, P. R., Lain, M. A., Drewelow, K. M., Urano, G., & Kerns, S. E. U. (2022). Influence of classroom-level factors on implementation fidelity during scale-up of evidence-based interventions. *Prevention Science*, *23*(1), 969–981. https://doi.org/10.1007/s11121-022-01375-3

Cooper, J. L., Sidney, P. G., & Alibali, M. W. (2018). Who benefits from diagrams and illustrations in math problems? Ability and attitudes matter. *Applied Cognitive Psychology*, *32*(1), 24–38. https://doi.org/10.1002/acp.3371

Crawford, L., Carpenter, D. M., Wilson, M. T., Schmeister, M., & McDonald, M. (2012). Testing the relation between fidelity of implementation and student outcomes in math. *Assessment for Effective Intervention*, *37*(4), 224–235. https://doi.org/10.1177/1534508411436111

Creswell, J. W., Hanson, W. E., Clark Plano, V. L., & Morales, A. (2007). Qualitative research designs: Selection and implementation. *The Counseling Psychologist*, *35*(2), 236–264. https://doi.org/10.1177/0011000006287390

Daroczy, G., Wolska, M., Meurers, W. D., & Nuerk, H. C. (2015). Word problems: A review of linguistic and numerical factors contributing to their difficulty. *Frontiers in Psychology*, *6*(348), 22–34. https://doi.org/10.3389/fpsyg.2015.00348

Design-Based Research Collective (DBRC) (2003). Design-based research: An emerging paradigm for educational inquiry. *Educational Researcher*, *32*(1), 5–8. https://doi.org/10.3102/0013189X032001005

Ford, C., McNally, D., & Ford, K. (2017). Using design-based research in higher education innovation. *Online Learning*, *21*(3). https://doi.org/10.24059/olj.v21i3.1232

Freeman-Green, S. M., O'Brien, C., Wood, C. L., & Hitt, S. B. (2015). Effects of the SOLVE strategy on the mathematical problem-solving skills of secondary students with learning disabilities. *Disabilities Research and Practice*, *30*(2), 76–90. https://doi.org/10.1111/ldrp.12054

Gani, M. A., Tengah, K. A., & Said, H. (2019). Bar model as an intervention in solving word problems involving percentages. *International Journal on Emerging Mathematics Education*, *3*(1), 69–76. https://doi.org/10.12928/ijeme.v3i1.11093

Ginsburg, A., Leinwand, S., Anstrom, T., & Pollock, E. (2005). *What the United States can learn from Singapore's world class mathematics system (and what Singapore can learn from the United States): An exploratory study.* American Institutes for Research. http://files.eric.ed.gov/fulltext/ED491632.pdf

Hembree, R. (1992). Experiments and relational studies in problem-solving: A meta-analysis. *Journal for Research in Mathematics Education*, *23*(3), 242–273. https://doi.org/10.2307/749120

Ho, S. Y., & Lowrie, T. (2014). The model method: Pupils' performance and its effectiveness. *The Journal of Mathematical Behavior*, *35*, 87–100. https://doi.org/10.1016/j.jmathb.2014.06.002

Ismajli, H., & Krasniqi, B. (2022). Constructivist instruction practices in Kosovo primary education: The field of languages and communication curriculum. *Journal of Social Studies Education Research*, *13*(1), 259–281.

Kaur, B. (2018). The why, what and how of the 'Model' method: A tool for representing and visualising relationships when solving whole number arithmetic word problems. *ZDM Mathematics Education*, *51*(1), 151–168. https://doi.org/10.1007/s11858-018-1000-y

Kho, T. H. (1987). Mathematical models for solving arithmetic problems. In *Proceedings of the 4th Southeast Asian Conference on Mathematics Education (ICMI-SEAMS)* (pp.345–351). Singapore.

Mcnamara, O., Jaworski, B., Rowland, T., Hodgen, J., & Prestage, S. (2002). *Developing mathematics teaching and teachers: A research monograph.* British Society for Research into Learning Mathematics BSRLM.

Ministry of Education, Science and Technology (MEST). (2016). *Curriculum Framework for Pre-university Education in the Republic of Kosovo.*

Morin, L. L., Watson, S. M. R., Hester, P., & Raver, S. (2017). The use of a bar model drawing to teach word problem solving to pupils with mathematics difficulties. *Learning Disability Quarterly*, *40*(2), 91–104. https://doi.org/10.1177/0731948717690116

Morina, Q. (2023). The impact of the SIMPLE strategy on word problem solving — a case study. In P. Drijvers, C. Csapodi, H. Palmér, K. Gosztonyi, & E. Kónya (Eds.), *Proceedings of the Thirteenth Congress of the European Society for Research in Mathematics Education (CERME13)* (pp. 3620–3621). Alfréd Rényi Institute of Mathematics and ERME.

Morina, Q., & Vondrová, N. (2021). Block model approach and its effect on word problem solving: A case study. In J. Novotná & H. Moraová (Eds.), *International Symposium Elementary Mathematics Teaching, Proceedings* (pp. 31–320). Charles University, Faculty of Education.

Nelson, M. C., Cordray, D. S., Hulleman, C. S., Darrow, C. L., & Sommer, E. C. (2012). A procedure for assessing intervention fidelity in experiments testing educational and behavioral interventions. *The Journal of Behavioral Health Services & Research*, *39*(4), 374–396. https://doi.org/10.1007/s11414-012-9295-x

O'Donnell, C. L. (2008). Defining, conceptualizing, and measuring fidelity of implementation and its relationship to outcomes in K-12 curriculum intervention research. *Review of Educational Research*, *78*(1), 33–84. https://doi.org/10.3102/0034654307313793

Osman, S., Che Yang, C. N. A., Abu, M. S., Ismail, N., Jambari, H., & Kumar, J. A. (2018). Enhancing pupils' mathematical problem-solving skills through bar model visualisation technique. *International Electronic Journal of Mathematics Education*, *13*(3), 273–279. https://doi.org/10.12973/iejme/3919

Özkubat, U., Karabulut, A., & Serhat, U. A. (2021). Investigating the effectiveness of STAR strategy in math problem-solving. *International Journal of Progressive Education*, *17*(2), 83–100. https://doi.org/10.29329/ijpe.2021.332.6

Pantziara, M., Gagatsis, A., & Elia, I. (2009). Using diagrams as tools for the solution of nonroutine mathematical problems. *Educational Studies in Mathematics*, *72*, 39–60. https://doi.org/10.1007/s10649-009-9181-5

Pearce, D. L., Bruun, F., Skinner, K., & Lopez-Mohler, C. (2013). What teachers say about student difficulties solving mathematical word problems in grades 2–5. *International Electronic Journal of Mathematics Education*, *8*(1), 3–19.

Perry, J., Lundie, D., & Golder, G. (2018). Metacognition in schools: What does the literature suggest about the effectiveness of teaching metacognition in schools? *Educational Review*, *71*(4), 483–500. https://doi.org/10.1080/00131911.2018.1441127

Polya, G. (1957). *How to solve it: A new aspect of mathematical method* (2nd ed.). Princeton University Press.

Pongsakdi, N., Kajamies, A., Veermans, K., Lertola, K., Vauras, M., & Lehtinen, E. (2020). What makes mathematical word problem solving challenging? Exploring the roles of word problem characteristics, text comprehension, and arithmetic skills. *ZDM Mathematics Education*, *52*(1), 33–44. https://doi.org/10.1007/s11858-019-01118-9

Rutakumwa, R., Mugisha, J. O., Bernays, S., Kabunga, E., Tumwekwase, G., Mbonye, M., & Seeley, J. (2020). Conducting in-depth interviews with and without voice recorders: a comparative analysis. *Qualitative Research*, *20*(5), 565–581. https://doi.org/10.1177/1468794119884806

Simon, M. A. (1995). Reconstructing mathematics pedagogy from a constructivist perspective. *Journal for Research in Mathematics Education*, *26*(2), 114–145. https://doi.org/10.2307/749205

Sterner, H. (2019). Teachers as actors in educational design research: What is behind the generalised formula? *LUMAT: International Journal on Math, Science and Technology Education*, *7*(3), 6–27. https://doi.org/10.31129/LUMAT.7.3.403

Teong, S. K. (2003). The effect of metacognitive training on mathematical word-problem solving. *Journal of Computer Assisted Learning*, *19*(1), 46–55. https://doi.org/10.1046/j.0266-4909.2003.00005.x

Ventistas, G., Ventista, O. M., & Tsani, P. (2024). The impact of realistic mathematics education on secondary school students' problem-solving skills: A comparative evaluation study. *Research in Mathematics Education*, advance online placement. https://doi.org/10.1080/14794802.2024.2306633

Verschaffel, L., Schukajlow, S., Star, J., & Dooren, V. W. (2020). Word problems in mathematics education: A survey. *ZDM Mathematics Education*, *52*(1), 1–16. https://doi.org/10.1007/s11858-020-01130-4

Windschitl, M. (2002). Framing constructivism in practice as the negotiation of dilemmas: An analysis of the conceptual, pedagogical, cultural, and political challenges facing teachers. *Review of Educational Research*, *72*(2), 131–175. https://doi.org/10.3102/00346543072002131

Yi, J. (2008). The use of diaries as a qualitative research method to investigate teachers' perception and use of rating schemes. *Journal of Pan-Pacific Association of Applied Linguistics*, *12*(1), 1–10.