Available online at ijci.wcci-international.org

International Journal of Curriculum and Instruction 14(2) (2022) 1301-1323

IJCI
International Journal of Curriculum and Instruction

Analysis of classroom teachers' storytelling in teaching mathematical skills

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Abstract

Storytelling is an important method for removing obstacles to learning mathematics and making lessons understandable. This research aims to analyze primary school teachers' stories written to teach students concepts of problem solving, fluency, reasoning, and understanding skills. The study is a qualitative case study and the participants were 25 classroom teachers. The data was analyzed descriptively using a qualitative program. The results of the research show that teachers can teach mathematical skills and the outcomes in the international mathematics curriculum through storytelling. However, their stories include little reference to the acquisitions of transferable skills that students can apply to other courses, such as interdisciplinary concepts and object modeling. In light of the results, an increase in trainee teachers' awareness of in-service training and undergraduate courses on subjects such as the acquisition of mathematical skills, modeling, and teaching interdisciplinary concepts is recommended. For this, alternative methods and techniques such as storytelling can be used.

Keywords: Mathematics teaching, classroom teacher, mathematical skills, storytelling

1. Introduction

1.1. Introduce the problem

Due to rapidly developing technology and changing needs, it is not enough for learners to be knowledgeable individuals. They are also expected to have skills such as problem solving, reasoning, fluency, and understanding. Problem solving, which is a crucial skill for people today, is the learners' ability to analyze, prove, evaluate, explain, interpret, and generalize (MoNE, 2019; OECD, 2019).

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According to Foster (2019), students should have the necessary fluency in important facts, procedures, and concepts and rich experience in reasoning mathematically in order to solve unfamiliar problems. As emphasized in Akkan's (2021) study, reading comprehension and mathematization are important in problem solving. Those who understand the problem situation make more fluent calculations and reason more accurately, efficiently, and effectively. Reasoning, which is one of the five strands of mathematical proficiency (Kilpatrick et al., 2001), is the ability of learners to analyze, prove, evaluate, explain, interpret, classify, and generalize with logical thinking capacity. In addition, students learn to explain what they chose and why when transferring information from one place to another, proving something is right or wrong, or comparing related ideas (Australian Curriculum, 2021). Fluency, which enables problem solving in a more effective and flexible way, is the ability of learners to get fast and precise results in the basic four operations (addition, subtraction, multiplication, and division) (Kabel et al., 2021; Musti-Rao et al., 2015; Nelson et al., 2016). However, this fluency is not only procedural fluency in computational skills based on fast processing. It is also a conceptual fluency that means understanding the learned mathematics (Akkan, 2021). With the development of this skill, learners can remember the definitions, realize the paths they need to follow to find the right answer to a question, and know accurately which equations and expressions they should use to find a solution to a problem (PISA, 2021). Development of fluency at an early age contributes to learners' feeling competent in mathematics later in their lives and their academic success in upper grades (Rushton et al., 2016). However, lack of this skill can lead to lifelong mathematics inadequacies such as simple calculation errors (Nelson et al., 2013). A low level of fluency means more time is spent calculating mathematical operations and puts a greater load on working memory. This can mean students have to devote more time to understanding the problem (Kilpatrick et al., 2001; Sullivan, 2011). The skill of understanding gives students the ability to make connections between the how and why of mathematics by changing or transforming mathematical concepts. In ordering numbers, they can easily combine and separate them and distinguish between addition and subtraction.

Given that many students perceive mathematics as difficult (Yasar & Papatga, 2015), it is important to encourage them to develop mathematical skills in easier ways involving daily knowledge and skills. Visual and mental modeling enables learners to learn concepts more accurately and quickly in new subjects. Modeling on the number line to solve newly learned multiplication and division topics resulted in more success for 2nd grade primary school students (Onal & Cilingir-Altiner, 2021). In order for learners to solve problems with effective reasoning, they need to model mathematically the steps to solving problems while interpreting any problems they encounter during the learning process. In

addition, in order to solve a problem by using spatial reasoning, they need to engage in a three-dimensional context mentally (Woolcott et al., 2020), and use modeling as a mathematical tool to concretize abstract objects (Albayrak & Ciltas, 2017).

Children learn more in-depth concepts when they have various opportunities to explore mathematics through experiences in the real world (Hobbs, 2019). Storytelling is one of the oldest teaching techniques. It facilitates communication, supports mental development, creates rich, vivid, meaningful, and permanent images for children, and is method by which cultural values are transferred between generations (Cokluk & Okmen, 2020; Ilter, 2014; Lacin-Simsek, 2019; Yeltekin, 2019). This method, which we are familiar with at a young age (Fusai et al., 2003), when combined with mathematics, enables support of learners' other learning as it requires the use of a cognitive area in which they are strong (Moyer, 2000; Thraikill, 1994). Storytelling is used in mathematics for purposes such as developing students' mathematical concepts and skills, posing intriguing problems, and improving mathematical vocabulary (Hong, 1996). Using stories that improve analytical thinking skills by motivating learners is a helpful technique for teachers for introducing, explaining and discussing mathematical concepts in a memory-supporting and memorable way (Zazkis & Liljedahl, 2009). It has been observed that it facilitates problem solving skills and teaching numbers in early age groups (Hassinger-Das et al., 2015; Kir, 2011; Yeltekin, 2019). In addition, it is known that storytelling in mathematics increases student success in division, and has a positive effect on certain mathematical skills such as comparing fractions, finding equivalent fractions, creating representations, and problem solving (Lemonidis & Kaiafa, 2019). Application of the storytelling method in the teaching of triangles and quadrilaterals in secondary school 5th grades, resulted in an increase in academic success in the experimental group (Ulupinar-Ozkuzukiran, 2020). The use of educational stories, analogies, and cartoons in mathematics education increases students' academic success. In addition, it helps change learners' attitudes towards the lesson in a positive way by reducing anxiety (Coskun, 2013; Efe, 2018; Katipoglu et al., 2021; Unuvar & Barut-Sezer, 2020). Stories that are useful in holding students' interest in the education process (Zazkis & Liljedahl, 2009) also help students realize alternative ways of approaching mathematical ideas and principles and increase their mathematical literacy (Koellner et al., 2009; Kusumastuti & Priatna, 2020). Combining mathematics with children's literature makes it easier for learners to associate mathematics with daily life, and to establish relationships with other lessons (Franz & Pope, 2005; Ilter, 2014). A rich and remarkable learning environment accelerates the systematic processing of information in a student's mind and makes this process more enjoyabl (Kog & Baser, 2011).

The use of active learning environments in mathematics, especially in primary schools, has a broad impact on increasing academic success (Sarier, 2020). In addition, technological and technical problems that can be experienced in digital stories (such as problems with and time spent accessing the internet) do not occur in traditional storytelling that do not use media tools and internet technologies (Talan, 2021). In addition, traditional storytelling can be considered a safer teaching method for learners, keeping them away from the harmful aspects of technology (for example, increased screen use in early age groups, technology addiction (Mustafaoglu et al., 2018).

1.2. Aim of the study

The foundation of mathematical skills that children will use in their future lives, such as problem solving, communication, and association, is formed in early childhood (Sarama & Clements, 2006). But examination of the literature shows that Turkish students score low in mathematical thinking and problem-solving skills in international exams taken by students aged, on average, 15 (Bozkurt et al. 2020). Comparison between primary school mathematics curricula and learning outcomes according to NCTM standards shows that they mainly lack reasoning and proof skills. In problem-solving skills, on the other hand, they achieve medium-level of success (Buyukalan-Filiz & Erkan, 2020).

Studies in the literature comparing the Turkish mathematics curriculum with programs of countries with successful indicators in international exams, show that mathematics programs do not differ much in terms of content (Bozkurt et al., 2020; Yagan, 2020). The only differences are in dimensions such as the application of achievements, examples related to the application to daily life, and being integrated with technology. For this reason, it is important that the mathematical achievements and the skills they depend on are given in a way that will attract students' attention, integrate them with real life experiences, and relate to their prior knowledge. This study compares Turkey's curriculum with that of Australia and that country leads in terms of the Human Development Index and has a higher success in international exams. In addition, in the literature, there are very few studies comparing the programs of the two countries (Yagan, 2020). In this respect, it is expected that the current research will contribute to the literature. The aim of the study is to enable classroom teachers to design stories to improve their students' problem solving, fluency, reasoning, and understanding skills. In addition, it aims to evaluate to what extent the mathematical concepts in the stories developed by the teachers reflect the relevant mathematical skills and whether they follow the international curriculum learning outcomes. In line with this general purpose, the study seeks answers to the following questions:

(1) How do primary school teachers include the concept of fluency in their stories?

(2) How do primary school teachers include the concept of problem solving in their stories?

(3) How do primary school teachers include the concept of understanding in their stories?

(4) How do primary school teachers include the concept of reasoning in their stories?

2. Method

In this study, primary school teachers were asked to create stories aimed to improve the mathematical skills of primary school students. The stories are to be used to motivate students to engage in the lesson, hold their attention, and activate their prior knowledge. The study was designed as a case study following qualitative research patterns. A case study is a qualitative research design in which in-depth analyzes are made with data collection tools based on multiple sources for one or more cases during the activity, and themes related to the situation or situations are created (Creswell, 2007).

2.1. Participant (subject) characteristics

The study group was determined based on criterion sampling. The characteristics of the study group formed with the voluntary participation of classroom teachers from various regions of Turkey are given in Table 1.

Table 1. Characteristics of the study group

Code	Gender	Age	Education	School Type	City	Professional Experience
TF1	Female	31-35	Master	Public	Diyarbakır	10 years
TF2	Female	41-45	Graduate	Public	Manisa	19 years
TF3	Female	26-30	Doctorate	Public	Mus	6 years
TF4	Female	45-50	Graduate	Public	Elazig	23 years
TF5	Female	41-45	Graduate	Public	Elazig	19 years
TF6	Female	41-45	Graduate	Public	Elazig	15 years
TF7	Female	55-60	Graduate	Private	Elazig	38 years
TF8	Female	41-45	Graduate	Private	Elazig	19 years
TF9	Female	45-50	Graduate	Public	Elazig	23 years
TF10	Female	36-40	Graduate	Public	Elazig	15 years
TF11	Female	45-50	Graduate	Private	Elazig	22 years
TF12	Female	31-35	Graduate	Private	Elazig	12 years

TF13	Female	26-30	Graduate	Public	Malatya	6 years
TM1	Male	36-40	Master	Public	Gaziantep	14 years
TM2	Male	26-30	Doctorate	Private	Antalya	6 years
TM3	Male	26-30	Graduate	Public	Mus	1 years
TM4	Male	26-30	Master	Public	Gaziantep	7 years
TM5	Male	36-40	Graduate	Public	Elazig	15 years
TM6	Male	31-35	Graduate	Public	Elazig	14 years
TM7	Male	36-40	Graduate	Public	Elazig	16 years
TM8	Male	41-45	Graduate	Public	Elazig	16 years
TM9	Male	36-40	Graduate	Public	Elazig	15 years
TM10	Male	45-50	Graduate	Private	Elazig	26 years
TM11	Male	55-60	Graduate	Private	Elazig	37 years
TM12	Male	41-45	Graduate	Public	Elazig	20 years

Table 1 shows that 12 of the participants were male and 13 are female and their ages range between 26 and 45. Of the participants, 7 teachers worked in private schools and 18 teachers worked in public schools and they were all teachers with 16-20 years of teaching experience. Most of the participants were from the province of Elazig and eight from outside the Elazig city.

2.2. Data Collection Tools

The learning outcomes of the activity were provided to the participants in advance for which they were asked to create stories. The stories were written on a Story Development Form, which was used as a data collection tool. A visual about the activity was provided at the top of the form to guide participants as they developed their story. The purpose of the visual was to draw participants' attention to students' prior subject knowledge and establish a relationship with daily life. An A4 hardcopy form was provided to ensure the stories were put into writing.

2.3. Interventions

The stories were designed based on the three content strands of the international mathematics curriculum focusing on numbers and algebra, geometry and measurement, statistics and probability. A total of 16 activities based on particular outcomes were created with the teachers, eight were designed for primary school 1st grade students and eight for primary school 2nd grade students. A total of four stories were created, two for 1st graders and two for 2nd graders and involving each skill. The chosen themes of the stories were plants, animals, outdoor activities, and food, themes students encounter in daily life. The following outlines the steps of the implementation process:

Step 1: A visual of one of the activities was projected onto a wall to provide the participants with a sample (Figure 1).

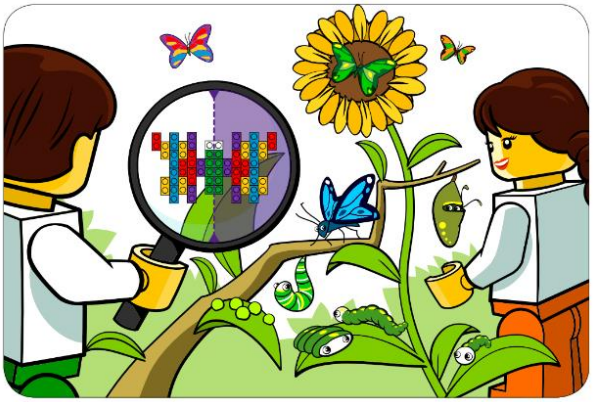

Figure 1. Butterfly activity

Step 2: The participants were informed about the learning outcomes of the activity. For example, the outcomes of ACMMG019, ACMMG022, and ACMSP263 in Table 2 for the butterfly activity were explained.

Step 3: The participants were asked to write their stories on the story development forms. As an example, the butterfly activity focuses on measurement and comparisons of measured objects. It also includes ordering of objects. The mathematical proficiency focus for this activity is fluency. The participants were expected to create a story with a plot that would develop fluency skills.

Step 4: A girl (Dila) and a boy (Kagan), who appear in all the stories, were chosen as characters students could relate to and given activities according to the context of the activity. An example story is as follows.

Dila and Kagan on a Country Trip

> *"Spring had just arrived. It was a nice weekend. Dila and Kağan went on a field trip with their families. There were colorful wildflowers, ladybugs, and gorgeous butterflies. Dila loved butterflies. She chased after a butterfly that landed on a flower. While examining the butterfly, Dila noticed something and called Kagan. The colors and shapes on the two wings of the butterfly were in interesting harmony. When they looked through a magnifying glass, they realized that the two wings were exactly the same, like a mirror image. The subject of symmetry in the math class came to Kagan's mind. His teachers were right; symmetry exists in nature."*

Step 5: Once the stories were written, the participants read them aloud to each other.

Step 6: The participants discussed how the stories were similar to or different from aspects of the Ministry of National Education's (MoNE) curriculum and what could be added to the sample scenario. Brainstorming was carried out on how to apply the stories developed in the classroom.

Information on the activities that were implemented is given in Table 2.

Table 2. Rubric of international achievements by mathematical skills

	Mathematical Proficiencies				
	Learning Outcomes	Reasoning	Problem Solving	Fluency	Understanding
ACMNA001	Establish understanding of the language and processes of counting by naming numbers in sequences, initially to and from 20, moving from any starting point.	X	X	X	
ACMNA002	Connect number names, numerals and quantities, including zero, initially up to 10 and then beyond.	X	X	X	
ACMNA003	Subitize small collections of objects.	X	X		
ACMNA004	Represent practical situations to model addition and sharing.	X	X		
ACMMG006	Use direct and indirect comparisons to decide which is longer, heavier or holds more, and explain reasoning in everyday language		X		
ACMNA012	Develop confidence with number sequences to and from 100 by ones from any starting point. Skip count by twos, fives and tens starting from zero.		X		
ACMNA013	Recognize, model, read, write and order numbers to at least 100. Locate these numbers on a number line		X		
ACMNA014	Count collections to 100 by partitioning numbers using place value		X		
ACMNA015	Represent and solve simple addition and subtraction problems using a range of strategies including counting on, partitioning and rearranging parts	X	X		
ACMNA026	Investigate number sequences, initially those increasing and decreasing by twos, threes, fives and ten from any starting point, then moving to other sequences.	X			
ACMNA027	Recognize, model, represent and order numbers to at least 1000	X	X	X	
ACMNA028	Group, partition and rearrange collections up to 1000 in hundreds, tens and ones to facilitate more efficient counting	X	X	X	
ACMNA029	Explore the connection between addition and subtraction	X	X	X	
ACMNA030	Solve simple addition and subtraction problems using a range of efficient mental and written strategies	X	X	X	
ACMNA031	Students can create models that are twice as large, twice as tall, and twice as wide. Can show and use repeating patterns in length, width, and height.				X
ACMNA033	Recognize and interpret common uses of halves, quarters and eighths of shapes and collections				X
ACMMG019	Measure and compare the lengths and capacities of pairs of objects using uniform informal units.				X
ACMMG037	Compare and order several shapes and objects based on length, area, volume and capacity using appropriate uniform informal units	X	X		X
ACMMG022	Recognize and classify familiar two-dimensional shapes and three-dimensional objects using obvious features		X		
ACMMG042	Describe and draw two-dimensional shapes, with and without digital technologies				X

ACMSP263	Represent data with objects and drawings where one object or drawing represents one data value. Describe the displays		X
ACMSP049	Collect, check and classify data	X	
ACMSP050	Create displays of data using lists, table and picture graphs and interpret them	X	

2.4. Data Analysis

The stories were analyzed with descriptive analysis. In the analysis of the data, female teachers were coded as TF1, TF2, etc., and male teachers were coded as TM1, TM2, etc. The analysis of the obtained data was coded by two independent researchers and the themes were determined. Analyzes were made in line with the concepts of mathematical skills and the keywords in the acquisitions. Analysis shows that teachers included in their stories learning outcomes beyond those covered by the international curriculum. These outcomes were also coded by the researchers in the story evaluation rubric. The data was analyzed descriptively through Nvivo 12.

The concepts of credibility, transferability, consistency, and confirmability (Yildirim & Simsek, 2016) were taken into account in ensuring the validity and reliability of the study. In order to ensure credibility, the data obtained was evaluated and discussed with an impartial researcher, and the cases were re-examined.

In terms of transferability, each stage of the study has been described in detail. In terms of confirmability, researchers attempted to be objective during the collection and analysis of the data, and the opinions of different researchers were taken into account when obtaining and correcting the results. In addition, Miles and Huberman's (1994) reliability formula was used to check the level of agreement between the codings. The analysis determined that the level of agreement between the codes was 93%. The differences between the codings were re-evaluated and determine in line with researchers' common opinions.

Results

3.1. Reasoning skill

According to the international curriculum, the achievements that should be included in the stories are given in the top line of the Table 3. The bottom section of the table, "Differences", shows the findings in the MoNE achievements in the teachers' stories that are beyond the international curriculum.

Table 3. Learning outcomes comparison of reasoning

Achievements	Keywords	Teacher Codes	Frequency
ACMNA001	Counting	TF1, TF2, TF4, TF5, TF6, TF7, TF8, TF9, TF10, TF11, TF12, TF13, TM1, TM2, TM3, TM5, TM6, TM7, TM8, TM9, TM10,	22

ACMNA002		TM12	
ACMNA003			
ACMNA004	Addition	TF1, TF2, TF3, TF8, TF9, TF10, TF13, TM1, TM3, TM4, TM5, TM7, TM8, TM9, TM10, TM11	16
ACMNA015			
ACMNA026	Length measurement	TF2, TF4, TF7, TF8, TF9, TF10, TF11, TM3, TM5, TM7, TM8, TM9, TM10, TM12	14
ACMNA027			
ACMNA028	Comparison	TF1, TF5, TF9, TF10, TM3, TM4, TM5, TM6, TM7, TM9, TM10, TM11, TM12	13
ACMNA029	Subtraction	TF1, TF4, TF9, TF10, TF12, TM1, TM9, TM12	8
ACMNA030	Grouping	TF3, TF4, TF6, TF7, TF9, TF13, TM5, TM7	7
ACMMG037	Mental operations	TF4, TF5, TF13, TM1, TM2, TM7, TM9	7
	Rhythmic counting	TF8, TF10, TF11, TM1, TM7	5
	Unknown number	TF1, TF3, TF8, TF11	4
	Sequencing	TF3, TM8, TM12	3
	Counting down	TF4, TM7	2
	Recognizing numbers	TF1, TM2	2

Differences

Keywords	Teacher Codes	Frequency
Interdisciplinary	TF1, TF2, TF3, TF4, TF6, TF7, TF9, TF10, TF12, TM1, TM2, TM4, TM5, TM6, TM8, TM10, TM11, TM12	18
Equal sharing	TF2, TF7, TF9, TF10, TF13, TM1, TM10	7
Table	TF7, TF9, TM4, TM6	4
Inequality	TF12	1

Examining Table 3 shows that the majority of participants used counting and addition expressions in their stories. The story extract below is an example of the expression of addition:

"*Dila sees that there are three eggs next to the white chicken, and Kagan sees that there are four eggs next to the green chicken. Kagan and Dila began to argue about how many eggs there were in total.*" (TM9)

It was also determined that teachers mostly emphasized the concepts of length measurement and comparison achievements from the determined acquisitions. The story extract below emphasizes the concepts of counting, length measurement, and comparison:

"*On the first day of the long jump competition, Dila jumped 18m and Kagan jumped 21m. Seeing that on the second day Dila jumped 5m longer than on the first day, Kagan said I jumped 2m longer than yesterday.*" (TM10)

What follows is a story extract that focuses on counting and mental operations:

"*Kagan takes a magnifying glass and counts the blackberries in the bush and sees that there are nine blackberries. He counts 10 blackberries in his basket. He thinks that he has 1 more in his basket.*" (TM7)

The teachers did not use concepts of volume, modelling, factorization, or area in the stories. Although the outcomes such as interdisciplinary skills, equal sharing, creating a table, and inequality are not in the structure of the activities, the teachers used them in the stories. The extract below is an example of the concept of equal sharing:

"*First they cut their friend's birthday cake, then they opened the boxes and shared the cookies evenly among their friends.*" (TF9)

3.2. Problem solving skill

Table 4 presents the findings related to the outcomes aimed at the activities and reflected by the teachers in their stories:

Table 4. Learning outcomes comparison of problem solving

Achievements	Keywords	Teacher Codes	Frequency
ACMNA001 ACMNA002	Groupin	TF2, TF3, TF4, TF5, TF6, TF8, TF9, TF10, TF11, TF12, TM1, TM2, TM3, TM4, TM5, TM6, TM7, TM8, TM9, TM10, TM11, TM12	22
ACMNA003 ACMNA004	Comparison	TF1, TF3, TF4, TF5, TF6, TF7, TF8, TF9, TF10, TF12, TF13, TM1, TM2, TM4, TM6, TM7, TM8, TM9, TM10, TM11, TM12	21
ACMMG006 ACMNA012	Counting	TF1, TF2, TF3, TF4, TF5, TF6, TF7, TF8, TF9, TF10, TF12, TF13, TM1, TM4, TM5, TM6, TM7, TM8, TM9, TM10	20
ACMNA013 ACMNA014	Recognizing numbers	TF1, TF2, TF5, TF6, TF7, TF11, TF12, TM1, TM2, TM3, TM5, TM6, TM7, TM9, TM10	15
ACMNA015	Addition	TF1, TF2, TF5, TF6, TF8, TF11, TF12, TF13, TM4, TM5, TM7, TM8, TM12	13
ACMNA027 ACMNA028	Subtraction	TF1, TF5, TF6, TF12, TM1, TM5, TM6, TM7, TM8, TM9, TM11	11
ACMNA029	Sequencing	TF1, TF8, TF9, TF10, TF12, TF13, TM1, TM4, TM6, TM7, TM8	11
ACMNA030	Mental operations	TF7, TF9, TF13, TM2, TM6, TM7, TM8, TM9	8
ACMMG037	Rectangle	TM11	1
		Differences	
Keywords		Teacher Codes	Frequency
Interdisciplinary		TF2, TF3, TF4, TF5, TF6, TF9, TF10, TF11, TF12, TF13, TM1, TM2, TM3, TM4, TM5, TM6, TM7, TM8, TM11, TM12	20
Equal sharing		TF5, TF13, TM1, TM5, TM8	5
Length measurement		TF4, TF13, TM1, TM11	4
Matching		TM10	1
Whole, half, quarter		TF12	1
Square		TM11	1

Table 4 shows that the participants mostly prioritized the concepts of grouping, comparison, counting, recognizing numbers, addition, and subtraction. The extracts below are examples of the concept of grouping:

"*Thinking that the toy car was 10 TL, they decided that 10 toy cars would cost 100 TL.*" (TM7)

"*The flowers are sold individually and as a bouquet. If you want one to nine flowers, I can make a bunch of them. We also have bouquets of 10.*" (TM1)

The following extracts are examples of the concepts of comparison, counting, and ordering:

"*First they did a lap around the track to warm up. Kagan said "let's count our steps." Kagan said, "I took 68 steps". Dila asked "why are my 76 steps not the same?" Kagan explained that because he is bigger, his steps are also bigger, and that is why they are different.*" (TM8)

"*As soon as her teacher got the assignment, the first thing she noticed was the snakes on the cover, arranged from small to large.*" (TF9)

Although modeling, multiple expressions were included in the activities, the teachers did not use them in the stories. It was determined that although they were not included in the activity outcomes, they included in their stories the keywords for outcomes such as interdisciplinary skills, equal sharing, length measurement, matching, quarter, half, whole, and square. The extracts below are examples related to matching for these outcomes:

"*When they placed the tulips in the vases one by one, they realized there were not enough vases.*" (TM10)

3.3. Understanding skill

Table 5 presents the findings of outcomes aimed at the activities and reflected by the teachers in their stories:

Table 5. Learning outcomes comparison of understanding

Achievements	Keywords	Teacher Codes	Frequency
	Equal sharing	TF2, TF3, TF5, TF6, TF7, TF8, TF9, TF10, TF12, TF13, TM1, TM2, TM3, TM4, TM5, TM6, TM7, TM8, TM9, TM11, TM12	21
ACMNA019	Half	TF1, TF2, TF3, TF4, TF5, TF7, TF8, TF9, TF10, TF11, TF13, TM1, TM2, TM5, TM6, TM7, TM8, TM9, TM10	19
ACMNA031 ACMNA033	Quarter	TF2, TF3, TF4, TF5, TF7, TF8, TF9, TF10, TF11, TF13, TM1, TM2, TM3, TM5, TM6, TM7, TM9	17
ACMMG037 ACMMG042	Comparison	TF1, TF2, TF3, TF4, TF6, TF8, TF10, TF12, TF13, TM1, TM3, TM5, TM7, TM9, TM10, TM11	16
	Width	TF1, TF2, TF3, TF7, TF9, TF10, TF13, TM1, TM3, TM7, TM11	11
	Length	TF3, TF6, TF10, TF12, TM5, TM7, TM9, TM10, TM12	9

	measurement		
	One eighth	TF1, TF2, TF4, TF10, TF13, TM2, TM4, TM6, TM9	9
	Whole	TF5, TF7, TF8, TF9, TF11, TM1, TM5, TM6, TM9	9
	Multiple	TF1, TF2, TF4, TF6, TF10, TF12, TF13, TM1, TM11	9
	One third	TF1, TF2, TF3, TF10, TF13, TM1, TM11	7
	Height	TF13, TM1, TM11	3
	2D shapes	TF8	1
	Area	TM3	1

Differences

Keywords	Teacher Codes	Frequency
Counting	TF1, TF4, TF6, TF7, TF8, TF9, TF11, TM2, TM3, TM4, TM6, TM7, TM8, TM9, TM10, TM11	16
Interdisciplinary	TF1, TF3, TF6, TF7, TF9, TF12, TM1, TM2, TM3, TM4, TM6, TM9, TM10	13
Sequencing	TF1, TF3, TF5, TF8, TF12, TM1, TM2, TM4	8
Mental operations	TM3, TM4, TM5, TM9	4
Time measurement	TF6, TF12, TM5	3
Addition	TM1, TM5	2
Subtraction	TM7, TM10	2
One fifth	TM1	1
Symbolization	TF8	1

The table shows that teachers frequently use equal sharing, half, quarter, and comparison outcomes. In addition, the teachers emphasized outcomes such as length measurement and multiples. They also included outcomes such as quarter, one-third, whole, and height in the activities. The following story extract is an example of the concepts of equal parts and length:

"*Their mother gave one of the 8 loaves of bread she brought with them to the children. The children divided the bread equally between 4 ducks and started to step the distance between the lakeside and the place where they had their picnic.*" (TM9)

Extracts showing emphasis of the concepts of half and quarter are as follows:

"*They saw that the lion was eating half the meat. The baby lion ate a quarter of the meat. Dila imagined pieces of meat as legos. The meat the lion ate was two legos, while the meat the cub ate was one lego.*" (TF4)

An example of a story extract in which expressions such as comparison and multiple are used together is given below:

"*They noticed that in front of the big lion there was a larger piece of meat than the baby lions had. When they took a closer look, they saw that there was a ratio between them. They found that the baby lion had a piece of meat in front of it that*

was three times smaller than the meat in front of the large male lion, and two times smaller than the meat in front of the lioness." (TF1)

The participants did not use the 3D view components, square and rectangular outcomes, in the stories. However, they used outcomes that were not included in the activities, such as counting, interdisciplinary skills, sequencing, addition, symbolization, subtraction, one-fifth, time measurement, and mental operations. An extract showing the concept of counting is as follows:

"*First, they checked the eggs. They saw that the eggs were in twos and they immediately started counting.*" (TF8)

3.4. Fluency skill

The findings of outcomes aimed at the activities and reflected by the teachers in their stories are given in Table 6.

Table 6. Learning outcomes comparison of fluency

Achievements	Keywords	Teacher Codes	Frequency
	Length measurement	TF1, TF2, TF3, TF4, TF6, TF8, TF10, TF11, TF12, TF13, TM1, TM2, TM3, TM4, TM7, TM8, TM9, TM10, TM11, TM12	20
	Comparison	TF1, TF2, TF4, TF5, TF6, TF8, TF9, TF10, TF11, TF12, TF13, TM1, TM2, TM5, TM6, TM7, TM8, TM9, TM10, TM11	20
ACMNA027	Counting	TF1, TF2, TF4, TF5, TF6, TF8, TF10, TF11, TF12, TF13, TM1, TM2, TM5, TM6, TM9, TM12	16
ACMNA028 ACMNA029	Symmetry	TF2, TF3, TF4, TF8, TF9, TF10, TF12, TF13, TM1, TM4, TM7, TM9, TM12	13
ACMMG019	Table/Chart	TF4, TF5, TF7, TF8, TF9, TF12, TM4, TM6, TM9	9
AGMMG022	Subtraction	TF4, TF5, TM1, TM3, TM10	5
ACMSP263	Addition	TF1, TF6, TF9, TM1, TM2	5
ACMNA030	Pattern	TF3, TM4, TM5, TM7, TM11, TM4	4
ACMMG037	Listing	TF3, TM2	2
	Reflection	TM8, TM4	2
	2-dimensional / 3-dimensional	TF3, TM7	2
	Using the measuring tool	TF8, TM7	2
	Half	TF8	1
		Differences	
Keywords		Teacher Codes	Frequency
Interdisciplinary		TF1, TF2, TF3, TF4, TF5, TF6, TF7, TF9, TF10, TF11, TF12, TM1, TM2, TM3, TM4, TM5, TM6, TM7, TM8, TM10, TM11, TM12	22
Sequencing		TF2, TF5, TF6, TF7, TF8, TF9, TF10, TF11, TF13, TM1, TM4, TM5, TM6, TM7	14
Recognizing numbers		TF1, TF3, TF8, TF11, TM3, TM9	6

Hour	TF12, TF10, TM3,	3
Rhythmic counting	TF3, TF4, TF13	3
Volume	TF8, TF11	2
Area	TF8, TF11	2
Grouping	TM9, TM10	2

Table 6 shows that the teachers mostly express the outcomes of length measurement, comparison, symmetry, and counting in the stories. The following story extract is an example of length measurement and comparison expressions:

"*Dila threw the cannonball 12 units away. Kagan, on the other hand, was able to throw his cannonball 13 units away. There wasn't much of a difference between them*." (TF10)

The extract below shows the concept of symmetry:

"*Shapes, patterns, and colors are evenly distributed on both wings. Just as he bends down to examine the length of the butterfly, the butterfly flew off again and began to dance.*" (TF13)

In addition to these outcomes, they also expressed those of creating tables/graphs, addition, subtraction, patterns, listing, and gains. However, the teachers did not emphasize outcomes such as length estimation, data collection or proof, which were addressed in the stories. It was also determined that they mentioned outcomes not covered by activities such as sequencing, counting, and volume. The extract below is an example of rhythmic counting expressions:

"*Since the wise ant could not see far, he approached the border of the garden and counted 5 and 10 each. After a while, Dila brought the lost glasses and gave them to the wise ant.*" (TF3)

In addition, the teachers included outcomes such as interdisciplinary skills, hours, grouping, and sequencing, which are not included in the activity acquisitions, in their stories. A story extract emphasizing the concepts of grouping and addition is given below:

"*He observes that the lengths of the wagons are different. He sees that there are 3 windows in the 1st and 3rd wagons, a single window in the 2nd wagon, 2 windows in the 4th, 5th, and 6th wagons and 13 windows in total.*" (TM9)

3. Discussion

This research examines stories created by classroom teachers based on three content strands of the international mathematics curriculum focusing on numbers and algebra, geometry and measurement, statistics and probability. The analysis

of the developed stories is important in terms of understanding at what level the MoNE and international mathematics learning outcomes are similar or different. The stories created by the classroom teachers in line with the activities were grouped as reasoning, problem solving, understanding, and fluency and examined separately.

It was concluded that in the stories focusing on teaching "Reasoning", the teachers did not mention modeling, factorization, or calculating the area of a geometric shape. Studies have shown that mathematical modeling and modeling are effective in associating students' daily life experiences with mathematics and solving problems (Celikkol, 2016; Ferreira & Jacobini, 2009; Muslu & Ciltas, 2016; Swan et al., 2007). The MoNE (2018) 1st grade mathematics curriculum includes modeling in teaching subjects. This suggests that it is important that teachers should actually address this outcome in their stories. In their stories, the participants included MoNE (2018) outcomes such as creating a table and counting by 4 by 5. However, in this study, very few of the teachers focused on teaching to these outcomes despite the literature stating that students' counting skills and sense of number improve with rhythmic counting and that it makes it easier to understand the relationships between numbers (Akkaya, 2019; Le Corre & Carey, 2007).

Examining the stories written by the participants for "Problem Solving" shows that they did not mention modeling. In addition, they did not address multiple expressions. Participants did mention the outcome related to mental operations. In addition, although they were not included in the learning outcomes, they referred to expressions such as interdisciplinary skills, equal sharing, matching, measuring units, half, whole, and quarter. These learning outcomes are included in the MoNE (2018) curriculum. It is also very important for teachers to include "matching" among these achievements because Charlesworth and Lind (2003) emphasize that matching is the basic component in learning the concept of number.

Within the scope of "understanding" activities, the concepts of width and height were included in the participants' stories. However, although the three-dimensional views of objects and the square and rectangle concepts are included in the activities, participants did not include them in their stories. this is despite the fact that giving views of objects from different aspects can contribute to students' modeling, comparison, classification, and sequencing skills (Hannibal & Clements, 2000). Studies show that teaching students about shapes with different dimensions is important for the development of their mathematical thinking (Ivrendi et al., 2018; Kesicioglu & Alisinanoglu, 2017). Participants also used one-third, one-eighth, one-fourth/quarter, and one-fifth concepts in their stories. In

the MoNE (2018) curriculum, only a quarter and half concepts are given. It was concluded that teachers generally use fraction expressions, which are multiples of each other, based on the MoNE (2018) curriculum.

Regarding "fluency" activities, the participants did not use the modeling outcome in their stories. Even if they addressed measurement of length, they did not emphasize the estimation of the measurement of length. In addition, they included in their stories the hour measurement, which is not in the international curriculum but is included in the MoNE (2018) acquisitions. In Lee's (2012) study, pre-service teachers mostly used expressions containing the concepts of money and time, as in this study. Teaching with storytelling is a technique that can be used not only to develop the procedural dimension of fluency in mathematics but also to provide a conceptual fluency that allows learners to learn the subject more deeply and relate it to real life. According to Akkan (2021), for effective mathematics teaching, the fluency skill should be addressed students' processing skills and interpretation (conceptual understanding). In this way, learners will be able to develop in other skills such as reasoning, problem solving, association, and communication.

In general, the participants included in their stories most of the outcomes in both the international curriculum and the MoNE curriculum because there is high similarity between the two curricula in terms of learning outcomes (Kazez, 2015; Yagan, 2020). Time in Turkey is taught with quarters and halves. The acquisition of minute calculations in time teaching are also included in the curriculum. However, these issues are not addressed in the international outcomes. This is one of the main outcome differences between the two curricula. In addition, the teaching of concepts such as weighing, measuring liquid, and calculating money in the international curriculum is different from the MoNE curriculum.

4. Conclusions

Examination of the stories of each mathematical skill in this study shows that there are some similarities and differences that arise from differences in culture. According to the findings of the study, the modeling skill was not mentioned and interdisciplinary concepts were used less. However, modeling is an outcome recommended to improve learners' mathematical literacy (Didis et al., 2016; Topbas-Tat, 2018). It is important that students are engaged in learning that develops their spatial skills and supports their modeling skills because, when the international outcome skills that students in this age group should have are not addressed in the classroom, they are incompletely learned. In this case, it is thought that these skills, which are not developed at an early age, may cause

students to be unable to model more complex questions in their future lives or to develop spatial rotation skills (Jones et al., 2002).

The participants in this study enjoyed developing stories. At the same time, it was noticed during the practice that they developed constructive criticism and thought more deeply about the subject while listening to each other's stories. Although they included the basic subject outcomes such as addition, counting, and subtraction, which they frequently used while teaching in the classroom, they gave little or no attention to outcomes focusing on division, modelling, geometric shapes, and object graphics. This is despite the fact that giving different sizes and positions and modelling geometric shapes contributes to the development of children's early mathematical skills such as sorting, classification, and comparison (Hannibal & Clements, 2000).

Since the participants rarely addressed interdisciplinary concepts, it can be assumed that they have difficulty in creating problems that can be used in daily life or they are not aware of it. To remedy this, training for creating daily life problems should be given to teacher candidates during in-service training or undergraduate study. It would be beneficial to support teachers on how to use the storytelling technique more effectively in their lessons.

Acknowledgements

We would like to thank Ms. Carol Williams for the proofreading of the article.

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