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# Experiences of classroom teachers on the use of hands-on material and educational software in math education

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**Abstract**

One of the most common challenges expressed by classroom teachers in mathematics teaching and in the literature is the concretisation of abstract concepts in teaching basic subjects. Lego MoreToMath is a training set focusing on the mathematical lesson gains of elementary school first and second grade students. The aim of this study is to enable teachers to experience Lego MoreToMath, which is a combination of building toys and educational software, by using the summer camp as a TÜBİTAK 4005 project. The study was conducted with 25 classroom teachers and their opinions were taken during the 1-week training process. Data were collected through observation and interview techniques by keeping field notes. In the study, a descriptive analysis approach was used as the data analysis technique. The teachers stated that using a different approach in mathematics teaching developed them professionally and they wanted to use such approaches in their lessons.

**Keywords:** Educational software, fluency, hands-on material, problem-solving, reasoning.

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## 1. Introduction

Since mathematics is a subject that meets the needs of the day and age in every period of history, it can not be thought of as independent of daily life. Therefore, the teaching of mathematics should be related to daily life (Bozkurt & Polat, 2011; Doruk & Umay, 2011; Tanisli & Yavuzsoy, 2011). Since mathematics is based on concepts and processes in a certain, logical order, it is necessary to create conditions in which students can recognize the order in mathematics to make sense of the subject (Van De Walle, Karp & Bay-Williams, 2012). However, when mathematics teaching is examined, it is noticed that the most advanced mathematics we give to students is still based on the analysis tools discovered by Newton 350 years ago. For this reason, mathematics lessons cannot be associated with daily life by students and are seen as difficult, time-consuming and requiring patience by many students in our country and around the world (Guven & Ozcelik, 2017). Therefore, students have a negative attitude towards mathematics (Alakoc, 2003; Cakir, 2012). Early interventions are important because individuals develop knowledge and attitudes about mathematics at an early age (Kubanc, 2012; Outhwaite, Gulliford & Pitchford, 2017). When we look at the cognitive characteristics of primary school children, it is seen that they are in what Piaget (1971) calls the period of concrete operations, in which they can understand the principle of conservation. Students have the ability to solve problems mentally, group objects and classify them according to their various characteristics. They can solve complex problems only as long as they are concrete. It is also a period in which a lesson should be close to the student's experience in order to be seen as a problem to be solved by the student (Senemoglu, 2013). When the students' early developmental characteristics and the abstract nature of the mathematics lesson are considered, it is clear that there is a need for teaching in relation to everyday life (Skemp, 1987). Because a concept in mathematics is not likely to be shown directly to the child, instead the concept should be shown to the child in a model to place it in his mind (Olkun & Toluk Ucar, 2014). In second grade, when children are in this period of concrete operations, another skill that is expected from them is reasoning. Reasoning means to give logical answers to questions of why and how, and to recognise shapes and classify numbers (Altiparmak & Ozis, 2005). The reasoning ability has to be developed with the appropriate strategies although it is a feature that every human being has from birth. The other two skills which are considered necessary besides reasoning and problem-solving in mathematics teaching are communication and relationship (Olkun & Toluk Ucar, 2014). To be able to explain what they do to reach a solution in order to activate the meta cognition, and to communicate this is seen as necessary for permanent learning. In addition, the ability to comprehend the relationship between geometry, measurement and data by connecting them together is another important point for effective mathematics teaching.

In order to teach mathematics effectively, it is possible to update educational programs (Ersoy, 2006; Kubanc, 2012) and to use concrete materials such as beads and beans. It has been found that the use of concrete materials helped students to understand the problem more clearly, to develop their own solutions more easily, to share their views with their peers and to build knowledge more easily with a wider perspective (Piskin Tunc, Durmus & Akkaya, 2012). It has been observed that virtual environments such as computers, tablet software and computer games have also increased the students' motivation and attracted their attention to the course (Outhwaite et al., 2017; Volk, Cotic, Zajc & Starcic, 2017). Mathematics teachers and teacher trainees also think that visualisation is important in mathematics teaching, improves persistence, provides effective use of time and provides more effective learning, and therefore they consider it necessary to make use of technology (Kiyici, Erdogmus & Sevinc, 2007; Kutluca & Tum, 2017). In particular, it is known that the use of materials in teaching in the second grade is very important in order to enable students to classify and compare objects and to make generalisations based on the similarities and differences of objects (Altiparmak & Ozis, 2005).

Lego, which is a concrete material that entered our lives as a building toy many years ago, nowadays provides students with the means to learn and gain knowledge and comprehension in courses such as mathematics, science and technology, to increase their motivation towards the course and to enable them to achieve task-based learning in cooperation (Kucuk & Sisman, 2017). It has been transformed into new systems by integrating it with computer and robotics technologies. Lego and robotic systems are used, especially with primary and secondary school students to obtain real-life gains, to embody abstract concepts, to gain skills such as problem-solving and critical thinking, to increase interest and motivation towards the course and to develop positive attitudes (Igel, Poveda, Kapila & Iskander, 2011; Kazez, 2015; Scaradozzi, Sorbi, Pedale, Valzano & Vergine, 2015). Lego has developed MoreToMath in the field of mathematics to improve the mastery of abstract concepts, which students have difficulty understanding in real life, to comprehend alternative problem-solving strategies and to understand fluently.

### *1.1. Lego MoretoMath*

MoreToMath (MTM) is designed for teachers of primary school grade 1 and 2 students, targeting the mathematics curriculum, including the mathematical proficiencies and mathematics content objectives. MTM is designed to develop students' problem-solving abilities as well as their vocabulary, especially reading, thinking, listening and speaking skills related to mathematical topics. It introduces and provides practice in mathematical proficiencies, including understanding, fluency, problem-solving and reasoning through individual and team problem-solving experiences. Students can model solutions for solving word problems, understanding number operations and algebraic thinking, building and dividing shapes, measuring and representing data, understanding place value and developing competency with all the mathematical proficiencies.

MTM consists of three major components: the international mathematics curriculum, interactive whiteboard software and 500 Lego bricks.

- *Curriculum:* The curriculum has 48 lessons in total (16 activity sets with 3 lessons each) and for each lesson there is one student worksheet. Each lesson is designed for a 45-minute class period. There are 24 lessons for Year 1 students and 24 lessons for Year 2 students.

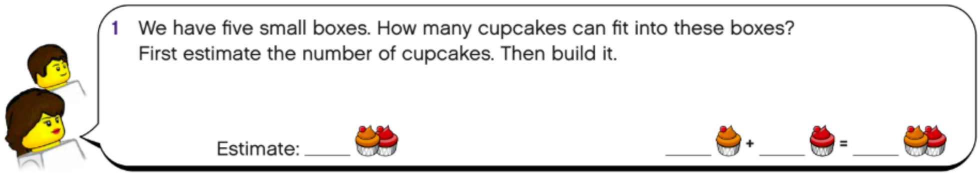


**Figure 1. Example of activity in curriculum**

- *Interactive whiteboard software (MathBuilder):* All activities provided in the curriculum as student worksheets (lessons), to be printed as hand-outs, are included in the MathBuilder software. All tasks in the speech bubbles can be displayed and all the tasks in the software can be built and solved on an interactive whiteboard in the classroom. The software allows students to model their solutions for given tasks. According to Kazez and Genc (2016), in the model, which can be prepared with Lego bricks either on the software or in real life, students can see their solutions on different models and share their solutions with each other.

**Figure 2. Example of software model**

- *Lego bricks:* Lego bricks are hands-on materials that can be combined with each other in accordance with the content of each activity theme.

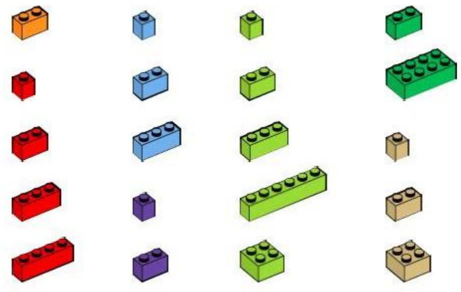

**Figure 3. Lego bricks**

In the classroom, teachers can select activities according to the ability of the students to work individually or in pairs, or to the mathematical skills (fluency, problem-solving, understanding or reasoning) to be taught. The number, colour and type of bricks that are expected to be used by the students in modelling a question are shown visually. Students are able to find solutions to each question and write a step-by-step process. The teacher can evaluate the performance of the activity with an evaluation rubric and a purple brick question is included on the worksheet. This is an extra question in case the student solves the questions given in the course quickly or if he/she needs to solve extra questions to understand the course. Observation forms prepared for each course in the curriculum aim to evaluate the performance of the students individually.

According to Van De Walle (1998), the representations used in mathematics teaching are concrete objects, pictures, written symbols, speech and real-life situations. When the activities in MTM are examined by researchers, it is understood that it supports the five features used in the creation of mathematical knowledge in different ways.

**Table 1. Comparison of MTM with representations in mathematics education**

| Major representation in mathematical education | MTM features |
|---|---|
| Concrete objects | Lego bricks |
| Pictures | Images used before activity to create students' own stories |
| Written symbols | Charts in activities |
| Speech | Explanation of the model which is created for cooperative or individual solution and / or made with Lego bricks |
| Real-life situations | Selecting the themes of the questions in real life |

Modelling with Lego bricks also improves students' psychomotor skills. In addition, it was concluded that mathematics education in which students worked with open-ended questions, software and Lego bricks on their own models had positive effects on their reasoning, fluency, problem-solving and comprehension skills (Kazez & Genc, 2016).

In this study, the process of TUBITAK 4005: Lego for Primary School Children Learning Mathematics is organised in order to increase the technopedagogical knowledge of the classroom teachers in a teaching environment where the use of building toys and technology is blended. The aim of the project is to provide an understanding of the physical models of classroom teachers who participate in the project in different cities, by using computer modelling, open-ended questions and investigating useful and deficient aspects of the activity according to their own experience. When the literature was examined on the emergence of the project, it was found that mathematics teachers rated their self-efficacy in the use of the material highly (Iskenderoglu, Turk & Iskenderoglu, 2016) but that in-service training personnel and teachers should be aware of the new technology (Piskin Tunc et al., 2012; Gokmen, Budak & Ertekin, 2016).

## 2. Method

### *2.1. Research model*

A case study of qualitative research designs was used in the study. A case study explores a current phenomenon with its own content within its boundaries. It is a type of research used in situations where there is more than one source of evidence or data, not yet a theory, but an observation-based, intensive description (Merriam, 2013; Yildirim & Simsek, 2016).

### *2.2. Study group*

The sample of participants in Turkey was determined on a voluntary basis from various provinces and consisted of 25 classroom teachers. The participants were determined by criterion sampling for purposeful sampling. They are mainly 36–40 and 41–45 years old and are experienced teachers. In terms of professional experience, the teachers have 16–20 years of teaching experience. Most of the participants in the study were from Elazig and eight were from outside the city.

### *2.3. Data collection and analysis*

The data collection phase of the study is divided into the pilot implementation and the main activity. First, a pilot study was conducted with the participation of five class teachers and the data obtained were used to shape the main activity. In the main activity, in order to solve the mathematical problems with the bricks and three-dimensional software, a total of 16 activities were carried out with the teachers and for the first and second grade classes.

**Table 2. Data collection tools**

| **Data collection tools used during implementation of activities** |
|---|
| a) Diary of activities: At the end of each activity teachers are asked four questions about the content of the activity. |
| b) Observation form: Individual observations are recorded independently by experts every day during the activity. |
| c) Story development forms: At the beginning of the activity, the visualisation of the relevant activity is shown in the software and the related picture is narrated in the given time. |
| d) Activity observation form: The prepared observation form about the activity gains at the end of the selected activity. |
| Data collection tools used after implementation of activities |
| e) Interview questions: A form consisting of 13 questions that were arranged and developed by the researchers after the pilot study was used as an evaluation tool in the data collection process. |

The data obtained after the study were analysed with the help of content analysis. Content analysis means bringing together similar data within the framework of certain concepts and themes and interpreting them in a way that the reader can understand (Yildirim & Simsek, 2016). In the analysis of the data, the teachers were coded as T1, T2, etc. The analysis of the obtained data was coded by two independent researchers and the different themes were expressed according to the opinion of the researchers.

In order to ensure the validity and reliability of the study, the concepts of credibility, transferability, consistency and confirmability (Yildirim & Simsek, 2016) were taken into consideration. The data obtained to ensure credibility were evaluated together with an objective researcher and the data were discussed. The cases discussed were re-examined together. Each phase of the study is explained in detail in terms of transferability. In addition, the data collection and analysis stages are explained in detail and the consistency between the data is shown. In terms of confirmation, an effort was made to treat the data objectively during the collection and analysis, and also the views of different researchers were used in the process of obtaining and correcting the results.

## 3. Findings and interpretation

The data obtained within the scope of the study were submitted to content analysis. The results are presented and interpreted according to themes and frequencies. In this context, three main themes were determined for the structure, implementation and instruction process of MTM. These themes and sub-categories are given below.

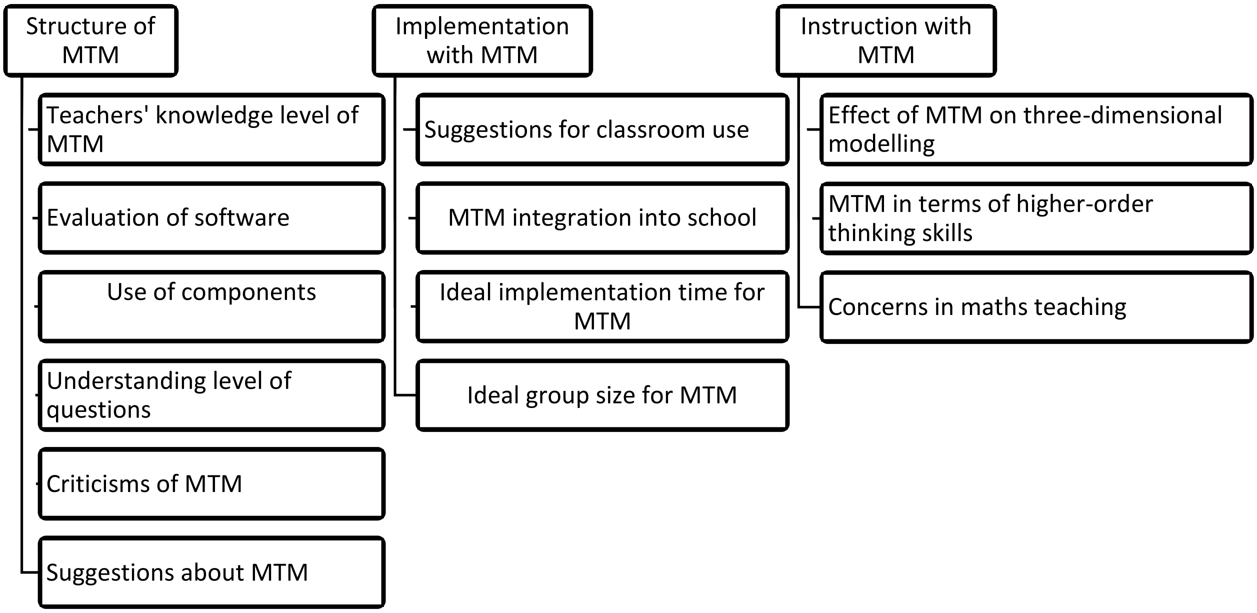


**Figure 4. Themes and sub-categories**

### *3.1. Findings about MTM structure*

#### *3.1.1. Teachers' knowledge level of MTM*

In the study, most participants stated that they had never heard of MTM before (*n* = 16). Participants had heard of Lego as a robot or as a toy (*n* = 8), and only one participant had encountered MTM when he was researching his field. For example, T10: 'Before this research, I knew that robotic studies with Lego were done, but I did not know that primary school students could use mathematics '.

#### *3.1.2. Evaluation of software*

The software was found to be generally easy to use (*n* = 17) but teachers claimed that the software should be in the Turkish language. In the software, some teachers had difficulty using the bricks (*n* = 4). According to the teachers, although the use of the software was generally found easy, some included statements about improving the expression. For example, T17 stated that 'Changing the rotation of the Lego bricks in the software is hard and a challenge'. Teachers stated that the software should be easily available and easily understandable for teachers and students and only Turkish language should be used.

#### *3.1.3. Use of components*

In terms of the teachers' preferences in the use of MTM's lego bricks and software components, the majority of the participants stated that they would prefer Lego bricks to the software in terms of ease of use and concrete materials (*n* = 21). T21 said 'I'd prefer to use Lego bricks. I think it is more permanent learning when the child works with bricks and is presented with a whole and a product. They handle the bricks and use trial and error. This way will be more useful'.

#### *3.1.4. Understanding level of questions*

According to five teachers, the questions were generally understandable by the students but the majority of teachers took the opposite view. This was because they thought that cultural differences could make it difficult for the students to comprehend the concept even though it was translated into Turkish, because MTM had been designed in accordance with the Australian curriculum (*n* = 14). For some activities, it was also stated that it is necessary to simplify the questions (*n* = 4) because of the high level of competencies expected from the students. Some participants stated that the questions at the second grade level were more comprehensible (*n* = 2). Some teachers thought that some questions in the activities should be asked at a higher level, as they were not suitable for the current grade's level of readiness. According to T11, some of the questions in the activities were not appropriate for the level.

#### *3.1.5. Critics of MTM*

Based on the criticisms of the teachers about the implementation, the findings in Table 3 were compiled.

**Table 3. Criticisms of MTM**

| Theme | Frequency |
|---|---|
| Needs progression of lessons from easy to difficult | 6 |
| Clear and unclear questions | 5 |
| Lego bricks are too small | 4 |
| Translation differences or cultural differences | 4 |
| Needs fewer courses and less implementation time | 2 |
| Sets are expensive | 1 |
| No comments | 3 |
| Total | 25 |

The most criticised point of the implementation was that the subjects did not progress from easy to difficult in the activity (*n* = 6) and that the questions in some courses were more appropriate to the beginners level. It was stated that open-ended questions would be more difficult for students to understand, and therefore the instructions in the questions should be more clearly explained. Also, Lego bricks are small for students (*n* = 4), expensive (*n* = 1), and the number of courses and the course times (*n* = 2) make it difficult to find time for class practice. Three participants did not make any criticism. According to T4, 'The bricks as a hands-on material could be a bit larger because the psycho-motor skills of the children have not yet developed, and Lego bricks are too small for students of the targeted age group'.

#### *3.1.6. Suggestions for MTM*

The recommendations of the teachers for the elimination of MTM's deficiencies are shown in Table 4. Some of the teachers made more than one proposal.

**Table 4. Suggestions for MTM**

| Theme | Frequency |
|---|---|
| Questions should be clearer | 10 |
| Questions should be easier | 5 |
| Number of questions within the activity should be increased | 4 |
| Rearrangement of questions from easy to difficult | 4 |
| Adding the missing learning outcomes according to the Ministry of Education | 3 |
| Using larger Lego bricks | 2 |
| Rearrangement of the order of activity | 2 |
| Adding videos to activities | 1 |
| Increasing the number of images | 1 |
| Total | 32 |

Teachers emphasised that questions should be understandable ($n$ = 10). Since the students had also only recently learned to read and write, they stated that the questions in grade 1 should be simplified ($n$ = 5). Increasing the number of questions in the activities ($n$ = 4), rearranging the questions from easy to difficult ($n$ = 4) and adding the missing learning outcomes according to the Ministry of National Education program ($n$ = 3) were also suggested. Lego bricks had to be separated after modelling ($n$ = 2), and teachers stated that the bricks should be bigger in view of the students' psycho-motor skills ($n$ = 2) and that the activity order should be rearranged ($n$ = 2). T16 stated that 'Questions should be easy to follow in a certain sequence and transition questions should be among the activities'.

### *3.2. Implementation with MTM*

#### *3.2.1. Suggestions for classroom use*

Classroom application should be limited to a maximum of 20 students ($n$ = 4). It was stated that students should not be placed in the classroom in the traditional order ($n$ = 1) and that a guidance teacher would be needed to help the class teacher in practice ($n$ = 4). Teachers stated that the implementation of the activity in the students' free time ($n$ = 3) would be beneficial for the students and that they would support teaching using MTM in Guidance Research Centres (RAMs) ($n$ = 4). It was also suggested that the classroom should have a smart board or projection device when using MTM. Increasing the number of activities to be done as a group work was also suggested in terms of increasing communication within the classroom.

**Table 5. Suggestions for classroom use**

| Theme | Frequency |
|---|---|
| Maximum 20 students per class | 4 |
| Must be an in-class guidance teacher | 4 |
| To be used in RAM units | 4 |
| Should be used during free activity hours | 3 |
| Non-traditional classroom layout (U or O order) | 1 |
| No suggestions | 9 |
| Total | 25 |

T15 stated that an extra classroom should be opened for this MTM implementation in the school. T19 stated that this training should be given to class teachers throughout the country. T17 suggested preparing guidance books for teachers, T10, T16 and T20 felt class sizes should be limited to 20 students, and in some cases, support teachers need to be available to assist teachers in the classroom.

#### *3.2.2. MTM integration into school*

Participants generally stated that MTM should be used in courses because of the concretisation of abstract concepts, increasing the participation in the class, the interest in the course, with material appealing to all activities (*n* = 17). However, some participants stated that it should not be used in all courses. They stated that this was important in terms of not bothering the students and not losing interest during the course (*n* = 8). T12 stated: 'Absolutely integrated. It will enable the concretisation of some abstract concepts. In addition to this, it will be a positive motivation for the students'. However, according to T21, 'No material should be fully integrated into a course. Other materials should be used where necessary. Because if a course always uses the same material to give examples, it will become boring and monotonous after a time. Not using MTM all the time is more useful'.

#### *3.2.3. Ideal implementation time for MTM*

Teachers expressed different views on how much time they would need to implement MTM. Although the process will vary depending on the number of courses per week, the maximum time suggested for these courses was 1 year (*n* = 11) and others stated that a term's course (*n* = 7) would be sufficient. The remaining seven teachers stated that the process would vary according to the students' abilities. T9 stated that 'I believe that the implementation of the whole of this practice should be extended to a school year. Two hours per week will be enough'.

#### *3.2.4. Ideal group size for MTM*

In the implementation of MTM, for the size of the groups, teachers think that it will be more practical to work with groups of 16–20 (*n* = 11) or with groups of 10–15 students (*n* = 7). Some teachers stated that they could divide the groups into four in crowded classes and that the number could then be 25 or more (*n* = 3). They also stated that as the age group gets younger, it would be more practical to reduce the group size. T19: 'Class size in practice is related to the teacher's control of the class. For example, my class consists of 41 students. I classify my class in groups and I would choose a group leader in each group. I was interested in leaders in groups of students'.

### *3.3. Instruction with MTM*

#### *3.3.1. Effect of MTM on three-dimensional modelling*

According to the teachers, the students should be able to improve their comprehension skills (*n* = 3), develop their spatial intelligence (*n* = 8) and develop different thinking strategies (*n* = 5) by using MTM modelling. They also think that the nature of this activity will improve the ability to rotate objects mentally (*n* = 6) and increase their learning by doing (*n* = 4). Table 6 shows teachers' views on the role of MTM in terms of 3D modelling.

**Table 6. Effect of MTM on three-dimensional modelling**

| Theme | Frequency |
|---|---|
| Increasing the development of spatial intelligence | 8 |
| Mental rotation ability | 6 |
| Development of different thinking strategies | 5 |
| Learning by doing | 4 |
| Increasing the ability to rotate 3-dimensional objects | 3 |
| Total | 26 |

T13 stated that 'I think that the students will be able to learn because they will perceive three-dimensional objects better by living, touching and modelling'. T6: ' I believe that children will change their perspective on three-dimensional objects and develop their imagination. Students can be researchers and become curious by using 3D modelling'.

#### *3.3.2. MTM in terms of higher-order thinking skills*

Teachers think that MTM can benefit students in gaining different thinking skills (*n* = 14), gaining knowledge that can be solved through alternative methods (*n* = 10) and developing the reasoning process (*n* = 8). In addition to these skills, teachers stated that MTM will definitely contribute to the learning of problem-solving (*n* = 4), learning by experience (*n* = 4) and estimating and predicting (*n* = 1).

**Table 7. MTM in terms of higher-order thinking skills**

| Theme | Frequency |
|---|---|
| Gaining different thinking skills | 14 |
| Solving problems in alternative ways | 10 |
| Development of the process of reasoning | 8 |
| Problem-solving | 4 |
| Learning by doing | 4 |
| Estimating | 1 |
| Predicting | 1 |
| Total | 42 |

T18 'Allows the student to produce his own solution without limit. Learn that a problem can have more than one answer. The student starts to think strategically and self-confidence increases'.

#### *3.3.3. Concerns in maths teaching*

Other than two of the teachers (*n* = 23), they all stated that they encountered various problems in mathematics teaching, as shown in Table 8. They stated that they experienced problems due to a lack of tools (*n* = 8), in teaching abstract concepts (*n* = 15) and material concretisation. In addition to this, the students' interest and motivation is low (*n* = 1), with distraction (*n* = 2), differences in in-class student levels (*n* = 4), prejudice against the mathematics course (*n* = 1) and less time for the curriculum (*n* = 2).

**Table 8. Concerns in maths teaching**

| Theme | Frequencies |
|---|---|
| Concretising abstract concepts | 15 |
| Lack of materials | 8 |
| Differences in student pre-knowledge levels | 4 |
| Distraction | 2 |
| Less time for the curriculum | 2 |
| Prejudice against mathematics course | 1 |
| Low interest and motivation | 1 |
| Total | 33 |

T7 stated that 'There may be problems in concretising abstract concepts and visualising and describing problems'. In order to solve the problems, the teachers stated that they use different methods and techniques, make frequent repetitions, make the lesson fun with games and try to comprehend the logic of the problem by interpreting the processes correctly. Moreover, they stated that they tried to solve the problems they encountered in mathematics education in the course by explaining the lesson in ways that move from simple to difficult, trying to embody the lesson with drawings and visuals or asking students to bring material from home.

## 4. Results, discussion and recommendations

Classroom teachers stated that they were forced to teach abstract concepts in mathematics, to teach different ways of thinking, to increase the interest and motivation of reluctant students and to deal with a lack of material for lessons. In the literature, it is observed that students' interest in the learning of mathematics has decreased. Because of the lack of material and the perception of mathematics as a difficult lesson, it is difficult to concretise abstract concepts in mathematics. So, teachers have difficulty in achieving the intended outputs (Dagdelen & Unal, 2017; Ural, 2015). However, it is known from the literature that software and hands-on materials can facilitate mathematics teaching and achieve the targeted learning outcomes (Piskin Tunc et al., 2012; Zengin, Kagizmanli, Tatar & Isleyen, 2013).

After this implementation, it is seen that teachers can use concrete materials and educational software together and they can easily use an application even if they have not done so before. Teachers think that the use of MTM in mathematics teaching will minimise the difficulties students face in mathematics. In addition, according to the teachers, with the concrete material, building toys and software that are used together in this application, students can gain different thinking skills, and can understand alternative ways to solve problems, learning by doing by making significant contributions to the learning process, and improving the process of reasoning. They stated that the use of MTM in the courses could increase students' spatial intelligence development and give students the ability to rotate the objects. One of the criticisms of the implementation is the need to correct cultural differences in the questions within the activities and conceptual confusion arising from the translation. The other is the need to increase the number of questions in each activity. In particular, teachers found that the class 2 activities were more appropriate for the level of students. They also stated that the language of the questions should be taken into consideration and made simpler and more comprehensible. The software was found to be easy to use, but it should be in Turkish. Besides, some teachers who have more professional experience but less digital literacy had problems with placing the bricks when modelling on the software. However, other teachers did not experience any problems with the software.

In addition, according to the teachers, missing activities and learning outcomes should be added to the questions and to the software according to the MEB curricula. It was suggested by teachers that it could be used as a tool in Guidance Research Centres (RAM). It was emphasised that it is ideal to work with small groups and to have fewer than 10 students if possible. However, since this situation will not be possible in public schools, they stated that a maximum of 20 students in four or five groups were ideal for practice. It was emphasised by the teachers that both the students' use of the software and their concrete models would need help from an in-class guidance teacher. It was stated by the majority of teachers that the MTM course would run for 1 year with 2 hours a week. In the event that the number of courses is increased, activities can be completed in a certain period but this period may change according to the abilities of the students. In cases where access to the both the software and the Lego bricks is difficult or expensive, the teachers indicated that they would choose the Lego bricks, considering the age group of the students. This is consistent with the finding that starting from concrete materials in the literature and then moving towards abstract materials will provide a more effective mathematics teaching environment (Fyfe, McNeil, Son & Goldstone, 2014).

As a result of this study, it can be suggested that there is a need to increase the in-service training of the class teachers. Because teachers participated in this study voluntarily, passing on their experiences to each other and even after the study ended, they urged that new training be made available on social networks and delivered to more people. Thus, it is understood that such training is useful for teachers to integrate their pedagogical knowledge with current technology. Also, it was found that using the software and building toys together was more effective than building toys or software only, but that if only one of them is to be used, the choice of building toys for early age groups will facilitate the teaching of mathematics. Teachers are advised to consider this when creating an activity. In addition to vocational, general culture and field courses in the undergraduate programs of the faculties of education, taking lessons related to the effective use of instructional technologies can be suggested in the future so that they can follow developments in their fields and use the effective tools correctly. Since the software used in the event was not open source, the desired changes could not be made or the changes made were not recorded and transferred to other devices. Therefore, it is thought that the production of domestic software that allows 3D modelling will be beneficial both for the economy of the country and for creating platforms that teachers can reach more easily.

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