

# How to Teach Coding through Stories in Early Childhood Classrooms

Burcu ÇABUK (cabuk@education.ankara.edu.tr, Ankara University), Gülgün AFACAN ADANIR (gafacan@ankara.edu.tr, Ankara University), Yasemin GÜLBAHAR(gulbahar@ankara.edu.tr, Ankara University)

## ABSTRACT

Computational thinking is important for everyone and focuses on solving problems, designing systems, and understanding human behavior through fundamental concepts of computer science. Early years are important for young students to learn coding, and at the same time, they can improve problem solving and computational thinking skills. Coding can be introduced to students through unplugged and plugged activities. Unplugged activities are more appropriate for young students since they contain concrete practices and teach main coding concepts in an entertaining, motivating, and challenging way in accordance with the developmental levels of children. Owing to this fact, the purpose of the current study was to demonstrate the implementation of stories as unplugged activities for teaching coding at an early childhood level. In the context of this study, preschool teacher candidates were considered and a 14-weeks-training (including theory and practice sessions) was implemented to teach computational thinking, coding concepts, and STEAM activities. After this training, teacher candidates engaged in creating unplugged activities to teach coding to preschoolers. In this respect, the study considered two different unplugged activities: Storigami (implementation of origami activities through stories) and Coding through Stories. Hence, 15 teacher candidates learned successfully how to teach coding and created various stories to teach coding to preschoolers. This paper introduces these activities as appropriate unplugged activities on the way of introducing coding concepts to young children. In the light of the findings, suggestions were presented to preschool teacher candidates, teachers, teacher training instructors and researchers.

## KEYWORDS

coding, early childhood, unplugged, story based learning

## 1. INTRODUCTION

Computational thinking was identified as a major skill for every person, not only for computer scientists. The concept of computational thinking was firstly proposed by Wing in 2006. According to Wing, computational thinking covers “solving problems, designing systems, and understanding human behavior, by drawing on the concepts fundamental to computer science” (Wing, 2006, p.33).

Computational thinking was proposed as a focused approach for problem solving, and at the same time integrating thought processes that employ abstraction, decomposition, algorithmic design, evaluation and

generalizations (Selby & Woollard, 2013). Abstraction refers to defining a problem or situation while focusing on information needed to solve the problem; decomposition means breaking data, operations or problems into smaller pieces; algorithmic design refers to designing the steps necessary to solve any problem; evaluation and generalizations involve evaluation of the solution and its generalization to subject domain.

Prior research has demonstrated that preschool children can build and program simple robotics projects (Wyeth, 2008) as well as they can learn ideas from engineering and computer programming while building their computational thinking skills (Bers, 2008). Computational thinking helps children develop fine-motor skills and hand-eye coordination while engaging in collaboration with other children and learn to work in teams. Furthermore, it allows preschool teachers to integrate academic content with the creation of meaningful products in a fun and playful technique (Resnick, 2003).

## 2. LITERATURE REVIEW

Digital literacy is seen as one of the essential skills of the twenty-first century, and provides students with gaining digital skills and learning coding (Judge, Puckett & Çabuk, 2004). Coding is defined as “the process of creating step-by-step instructions a computer understands and needs in order for its programs to work” (McLennan, 2017, p.1). Early years are important for young students to learn coding, as well as they can improve problem solving skills and computational thinking (Lee & Junoh, 2019).

Coding can be introduced to students through unplugged and plugged activities. Unplugged activities are “a widely used collection of activities and ideas to engage a variety of audiences with great ideas from Computer Science, without having to learn programming or even use a digital device” (Bell & Vahrenhold, 2018, p. 497). While teaching coding to young students, unplugged activities should be initially employed (Lee & Junoh, 2019) since they are more developmentally appropriate for young students and contain concrete practices and teach main coding concepts in an entertaining, motivating, and challenging way (Battal et al., 2021).

At early childhood level, it is important to introduce directional words (e.g. move forward, move backward, turn left, turn right) and sequential words (e.g. first, second, third) before starting any coding activity (Lee, 2020). After this introduction, learners can be provided with a grid-paper activity to understand the movements through



directional and sequential words. Finally, for the developmental needs of young children, the most essential activity to reinforce these coding skills is a movement game that also supports the children's gross motor skills.

Unplugged activities are more appropriate for the age group 2-7 and can be provided without using digital devices (Saxena et al., 2020). Unplugged activities are based on various methods like games, teamwork, tricks and employ various objects like cards, boards and stickers (Nishida et al., 2009). Stories are one of the methods used while implementing unplugged activities at the early childhood level. Stories can be employed for demonstrating events by time sequence (Lee & Junoh, 2019).

Picture storybooks have an indisputable importance for the progress of children especially in cognitive, social-emotional and language development and for supporting their education in early childhood (Deniz & Gönen, 2020). Stories are also used as one of the dynamic assessment methods. Creating a story by looking at a picture book or other materials and talking about personal experiences related with the written materials are some of the good practices used in early childhood settings (Işitan & Turan, 2014).

Storigami technique, known as storytelling accompanied by origami, which is the art of paper folding, has great benefits in terms of reflecting the multifaceted development, change and difference seen in early childhood to the child and his/her life (Tanju Aşışen, 2021). While doing storigami activities, creativity, aesthetic perception, sense of success, focusing attention, following the model, seeing different perspectives, part-whole relationship, cooperation, obeying the rules, problem solving, expressing feelings and thoughts artistically, self-confidence, hand and finger muscles, expressing oneself verbally, three-dimensional thinking and etc. are developed (Tuğrul & Kavici, 2002).

### 3. METHODOLOGY

#### 3.1. Procedure

In the context of this study, preschool teacher candidates were considered and a 14-weeks-training (including theory and practice sessions) was implemented to teach computational thinking, coding concepts, and STEAM activities. In each week, teacher candidates are involved in online training sessions. Each session takes approximately two hours and covers theoretical and practical concepts. After each session, teacher candidates were required to create related activities to be used in early childhood classrooms.

One session of the training covers the concepts of Storigami and Coding through stories. After this session, teacher candidates engaged in creating activities related to Storigami and Coding through stories. Each candidate planned and implemented the activity and at the same time recorded the implementation of the activity as a video file. Then, they shared their video recordings.

#### 3.2. Research Questions

The study considered teacher candidates' implementation of two different unplugged activities: Storigami (implementation of origami activities through stories) and Coding through Stories. In this respect, this study focused on the following two research questions:

- RQ1: Which Storigami activities were offered to be used in early childhood classrooms by teacher candidates?
- RQ2: Which Coding through story activities were offered to be used in early childhood classrooms by teacher candidates?

In this respect, the study also considered the following research questions (i.e. Table-1) in order to deeply analyze Storigami and Coding through activities.

Table 1. Research Questions

Research Questions
What activities were elaborated by teacher candidates?
What goals were included in the proposed activities?
What skills will be developed through proposed activities?
What materials are needed for the proposed activities?

#### 3.3. Research Design

The study employed a qualitative research design. The activities created by teacher candidates were investigated according to their overall structure and the computational thinking concepts covered.

#### 3.4. Participants

The participants are 15 teacher candidates studying in the Department of Early Childhood Education at a state university in Turkey.

#### 3.5. Data Collection and Analysis

The video recordings shared by teacher candidates were collected and qualitative analysis was conducted to investigate activities. The activities were evaluated based on research questions of the study. That is, each activity was examined with respect to their goals, materials, sub activities as well as the computational skills that activity addressed.

## 4. RESULTS

#### 4.1. Storigami Activity Sample

Storigami is a combination of origami (i.e., the art of folding paper) and storytelling. As the printed material, the activity only needed colorful papers. In the Storigami activity, teacher candidates tell the story to the audience and at the same time make origami with the story. Each fold or step in the origami process is directly related to an event in the story. While teacher candidates are telling the story, they recorded the storigami as the video file. One sample storigami activity is provided in the following figures.

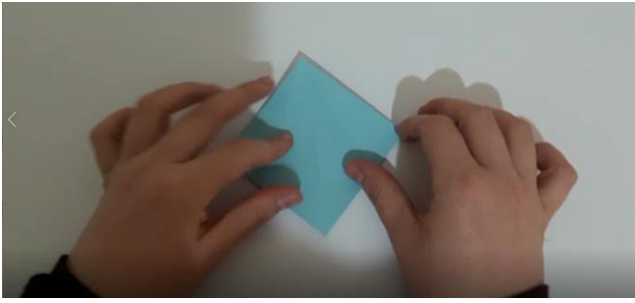


Figure 1. Storigami activity

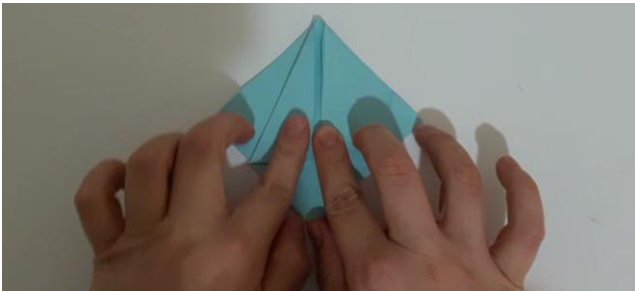


Figure 2. Storigami activity

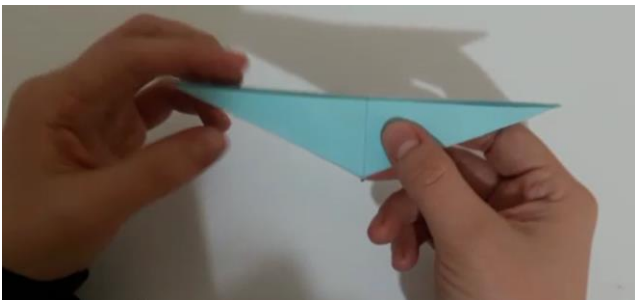


Figure 3. Storigami activity

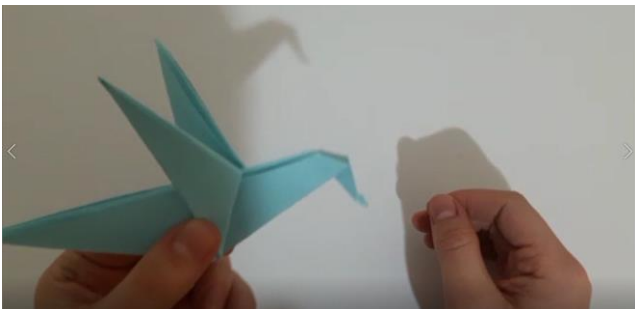


Figure 4. Storigami activity

The story of the activity was as follows:

*“In one of the countries there was a blue sky. This sky was so lonely that there was no one around and he was bored. He said that if there is no one, then I will fold and shrink. The sky was very small now, but there was still no one around. Well, he said then, let's do some sports. He folded his right arm, folded his left arm, overturned, folded his right leg, folded his left leg, then suddenly spread his legs, stretched, stretched, and stretched. Turned over, arms outstretched, stretched, stretched, stretched. The sky was still very bored. He said “I wish I was a ship, I wish I was floating in the waters. Maybe I would be a sailboat.” At that moment, a bird began to wander in the sky with its huge wings. The sky was very happy when he saw the bird, and now all his troubles are gone.”*

This activity addressed pattern recognition and algorithm design aspects of computational thinking. Pattern recognition aims to identify similarities or patterns in problems (Barrón-Estrada et al., 2022). In the context of the storygami activity, shapes have some patterns that need to be recognized by listeners. Algorithmic design is for developing steps or rules in order to solve any problem (Wu & Su, 2021). According to the storygami activity, teacher candidates follow and explain an ordered set of steps to create the shape.

#### 4.2. Coding through Stories Activity Sample

In this activity, teacher candidates need papers, colorful tapes, and tree-like materials that can be collected from a forest. In this activity, the purpose is to define a route between bees and a hive. The route includes a step-by-step algorithmic logic and is defined by using the start, forward, turn right, and turn left commands. At the same time, solutions should consider the obstacles in the route. The materials are provided in the printed format as in the following figure.



Figure 5. The materials of the activity

The materials were introduced and the story was provided to kids before starting the activity:

*“It was a warm spring day. Everywhere was full of flowers. Over the flower field, the honeybee was flying. The bee first flew up and down to collect its pollen. She visited the flowers one by one. He then flew two up, one right, and reached the tree. Other siblings came as well. They reached the hive by flying one up and three to the right to make honey for the pollen they collected together. They made such delicious and fragrant honey that the bear, the most honey-loving animal in the forest, smelled the honey. The bear was very hungry. He set out for the hive. When he came to the hive, he asked the bees for a piece of fragrant honey. He began to enjoy the honey given by the bees. This was the most delicious honey the bear had ever eaten.”*



Figure 5. Coding through stories activity

According to this story, the following steps were followed:

1. On the coding material with grids, it was emphasized to the students that every frame is a step, that the steps should be done in sequence (algorithm logic), and that the wrong step would be returned to the beginning.
2. Code blocks (symbols) were introduced to the students.
3. It was emphasized that obstacles are trees and flowers.

Students comprehended "coding", which is the logic of programming, by enjoying and playing games. It was observed that the students enjoyed playing with the material very much.

## 5. DISCUSSIONS AND CONCLUSION

During the Storigami activities, it was determined that 15 pre-service teachers both improved themselves in addressing students, providing control, being a model, and supporting their students, as well as directing their students' development in "coding". Parallely, in Unan, Aksan & Celikler's study, where the aim was to assess preschool teacher candidates' view on the forming and using living being models through origami for teaching in preschool, it was found out that these activities help facilitate their teaching skills and the students' learning.

In the study, it was determined that pre-service teachers felt good in teaching the subject of coding in the activities they prepared through stories and colorful costumes and materials, and they were able to scaffold the students' learning. It was also concluded that the students learned "coding" easily by hands-on activities using stories, and they participated in the activities with pleasure. Similarly, in a study aiming to introduce algorithm education activities developed on the basis of computer-free coding education for preschool children and to examine the application process of these activities, it was identified that the children participated in the activities fondly, actively participated in the coding activities, and by developing more than one solution proposal to the problem situations, they learned coding and algorithm concepts in an 8-week period (Kucukkara & Aksut, 2021).

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