# Pre-service mathematics teachers' understanding of geometric concepts through writing jokes

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This study aimed to understand how geometric concepts were integrated into jokes and which contexts were preferred in the jokes. For this purpose, pre-service teachers were asked to write jokes related to geometry at the end of a Geometry course and 41 written documents were included in the data set. The data were analyzed through content analysis in a qualitative data analysis software called MAXQDA (VERBI Software, 2019). The geometric concepts used by the pre-service teachers included polygon, line, angle, circle, point, ray, line segment, plane, diagonal, edge and disc. The most frequently used geometric concept was polygon. Among the polygons, pre-service teachers mostly used the triangle and addressed various aspects of a triangle such as triangle types, properties of triangles, auxiliary elements and concepts related to the triangle. For the contexts, the pre-service teachers mostly preferred personification, assigning human qualities and attributes to geometric concepts in the jokes.

**Keywords: geometric concepts; document analysis; pre-service teacher education.**

## Introduction

Humor is a way to arouse students' interest in academic subjects (Cleaver, 2008). Humor can be used as both oral or written in classrooms (Banas, Dunbar, Rodriguez & Liu, 2011). Studies have shown that when texts based on humor, for instance in comics and cartoons, were used, students' motivation and interest in learning mathematics increased (Cho, 2012). It was also reported that engaging pre-service teachers in comics and cartoons during teacher education courses could help them design learning environments in which students would enjoy doing mathematics (Cho, Osborne & Sanders, 2015).

Studies have also revealed that using comics while teaching mathematics has the potential to reduce students' level of mathematics anxiety (Sengul & Dereli, 2010; Whyte & Anthony, 2012) and might create enjoyable and positive classroom environments (Bakar & Amran, 2020). Moreover, using humorous situations to exemplify concepts in mathematics lessons might encourage long-term retention of the concepts (Garner, 2005; Martin, 2007). Humor can be used as a tool in teaching mathematics because it can enhance students' learning and understanding and improve critical thinking skills (Bolton-Gary, 2012).

Humorous materials can be utilized in various ways in mathematics teaching. This can include using existing humorous materials that has been published in a newspaper or magazine and that contains mathematical concepts or using materials that were designed particularly for mathematics classrooms (Aschbacher, 2015; Dabell, Keogh & Naylor, 2008; Gonick & Smith, 2015). In addition, having students create their own materials that reflect their mathematical understanding and thinking is

another way of using humorous materials. Papert (1993) suggested that the best learning experiences occur when people design and create things, especially things that are meaningful to them or others around them. Therefore, providing students with opportunities to create and design their own humorous materials is important. Having students create their own comics can promote their academic literacy, higher-level thinking and creativity (Pelton & Pelton, 2009). Furthermore, creating comics helps students make connections between mathematical concepts while representing and communicating their understanding (NCTM, 2000). In addition, research showed that when the students created their own comics, they were more involved in challenging mathematical tasks (Toh, 2009).

Geometry is an integral part of the mathematics curriculum. Therefore, it is crucial to know how students develop an understanding of geometric concepts and to overcome their existing difficulties. For this reason, determining the level of pre-service teachers' knowledge about geometric concepts and raising their level of understanding are necessary for effective teaching. In this sense, pre-service teachers can convey their understanding of a geometric concept through creating jokes. In this study, we asked pre-service teachers to write jokes and challenged them to think mathematically and to be more creative in order to deepen their mathematical knowledge. Thus, the purpose of the study is to determine how geometric concepts were integrated into jokes and which contexts were preferred in the jokes written by the pre-service elementary mathematics teachers. For this purpose, the following research questions were formulated:

1) Which geometric concepts were used by the pre-service teachers in the jokes?
2) Which geometric properties were addressed by the pre-service teachers in the jokes?
3) Which contexts were preferred by the pre-service teachers in the jokes?

**Method**

In this study, 41 pre-service teachers were asked to write jokes related to geometric concepts at the end of a teacher education course on geometry. This course is a first-year course in the Elementary Mathematics Education program in one of the universities in Turkey. Forty-one jokes were collected as participant-generated data. In the study, we used document analysis, a qualitative research method, to examine and interpret data in order to elicit meaning and gain understanding.

We analysed the data using the qualitative data analysis software MAXQDA (VERBI Software, 2019). The data were analyzed using content analysis since the main purpose in content analysis is to reach concepts and relationships through systematic review of the written data. In order to ensure trustworthiness of the study, referential adequacy (Lincoln & Guba, 1985) was used. Referential adequacy is a technique that is used to reveal credibility through archiving data and returning data. The first half data is analyzed while second half of the data is achieved. Then, the second half of data is analyzed as compared to the first half. By using referential adequacy, we checked findings and interpretations against the raw data to improve the quality of inferences.

Data were analyzed by two of the researchers individually and discrepancies were resolved through a discussion with the involvement of the third researcher and consensus regarding the codes and categories was reached. Moreover, the confidentiality of the data was protected and only researchers had access to the data and codes. In addition, personal anonymity was maintained, and the data had no identifying

information. Participants were also informed regarding the use of data and consent was obtained for the use of the material.

**Findings**

For the first research question, "which geometric concepts were used by the pre-service teachers in the jokes?" we found that the pre-service teachers used polygon, line, angle, circle, point, ray, line segment, plane, diagonal, edge, and disc in the jokes as geometric concepts (see Figure 1). Polygon was by far the most frequently used geometric concept in the jokes.
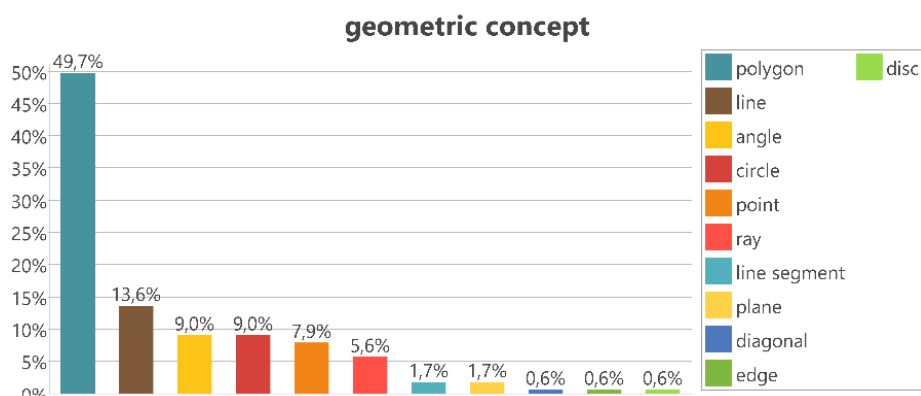


Figure 1: Distribution of geometric concepts used by the pre-service teachers in the jokes

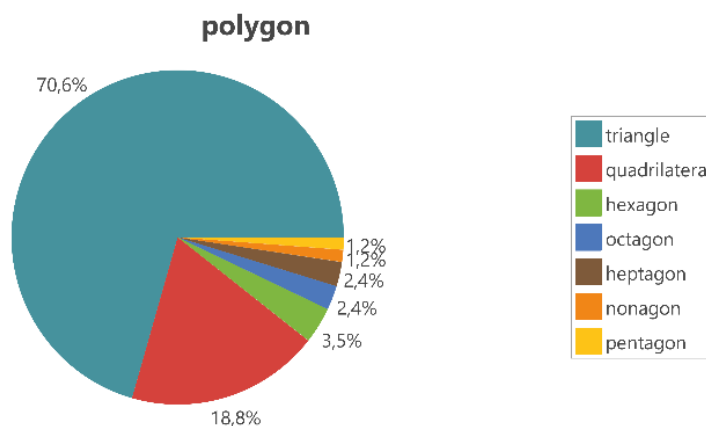Among polygons, triangle was the most frequently used (see Figure 2).



Figure 2: Distribution of polygons used by the pre-service teachers in the jokes

The pre-service teachers referred to properties of quadrilaterals; e.g., that quadrilaterals are formed by joining two triangles, and square, rectangle, trapezoid and rhombus are the types of quadrilaterals. They did not include parallelogram and deltoid as quadrilateral types in the jokes. Among quadrilateral types, pre-service teachers particularly focused on square and regarded square as a regular shape because of intersecting diagonals at the center, equal side lengths and right angles.

The pre-service teachers addressed triangle types by angle and side, concepts related to triangle, relations in a triangle such as Pythagorean Theorem, properties of a triangle such as least number of elements and sides by comparing triangle with other polygons and auxiliary elements in triangle such as angle bisector and median.

For the concept of line, the pre-service teachers mentioned properties of lines such as infinite length, the mathematical definition of a line according to Euclidean geometry and the definition of a line according to a dictionary. Moreover, they addressed parallel lines but not perpendicular or intersecting lines.

For the concept of circle, the pre-service teachers mentioned elements of a circle such as center, diameter, radius and circumference. A few pre-service teachers also mentioned the inscribed circle of a triangle. For the concept of angle, the pre-service teachers addressed types of angles according to their size consisting of acute, right, obtuse, and reflex angles but not straight angle and full angle. They also referred to angles in parallel lines including corresponding and alternate angles. They also mentioned units of measurement for angles; that are degree, radian, and gradian. For the concept of point, pre-service teachers referred to its properties such as non-dimensional aspects.

For the second research question "which contexts were preferred by the pre-service teachers in the jokes?" we looked at the code statistics for contexts. As seen in Figure 3, pre-service teachers mostly used personification as a strategy to create jokes. If pre-service teachers assigned human qualities and attributes to geometric concepts in the jokes, such as making them speak, contexts of these jokes were categorized as personification. In addition, they used dialogues between students and a teacher in mathematics lessons or dialogues between pre-service teachers and an instructor in a geometry course or in a geometry exam. Thus, in these contexts, classroom environments were selected as settings in the jokes. Temel/Dursun, a well-known type of jokes in Turkey, was the other context preferred. These jokes involve two people named Temel and Dursun who live in the Black Sea area and have funny adventures in the jokes. Temel/Dursun jokes can be considered simply as funny stories and are very popular in Turkish literature. In the present study, contexts of jokes including Temel, Dursun or both were categorized as Temel/Dursun. Furthermore, the pre-service teachers used court, trips, farming, fishing, family environment and birthday party as daily life contexts in which people act on a daily basis. In addition, a few pre-service teachers also used fairy tales in the jokes. The contexts of jokes that take place "once upon a time" were categorized as fairy tale.
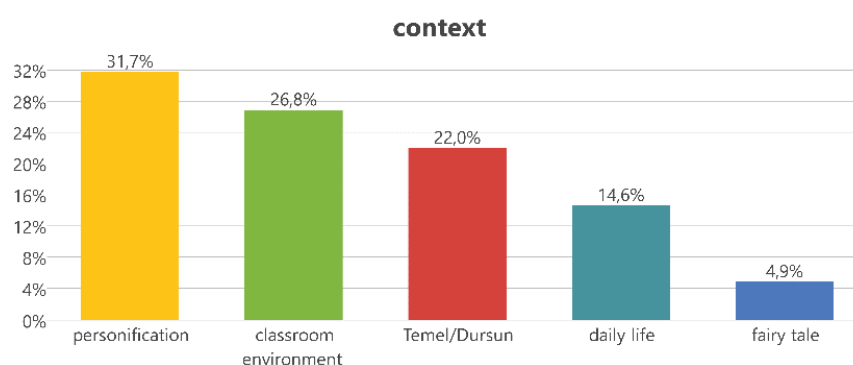


Figure 3: Distribution of contexts preferred by the pre-service teachers in the jokes

## Discussion and Conclusion

In Turkey, students start to learn about polygons from a young age. In the Turkish elementary mathematics curriculum, objectives related to polygons begin in the 1st grade. Therefore, pre-service teachers are familiar with this concept. To use the content in humor, they may need to have a solid conceptual knowledge. This can be the reason why polygon was the most used geometric concept by the pre-service teachers. In

addition, polygons may seem more concrete than other concepts such as point, line, ray, line segment that are abstract. That is, the fact that polygons can be easily connected to real life makes polygons ripe for humor.

The use of comics not only provides teachers opportunities to combine content with contexts, but also it permits students to consider some of the issues taking place in the context (Reilly, 2015). Similarly, in the present study writing jokes enabled pre-service teachers to combine geometric concepts with the contexts they preferred to use. For instance, by using classroom environment context, pre-service teachers brought their own experiences in learning geometric concepts during the Geometry course to the jokes. Thus, it can be said that allowing pre-service to create jokes can give information about their own personal background, experiences and how they use mathematical language.

By creating comics and jokes, pre-service teachers can reflect upon their own understanding or misunderstanding of a concept, confusion and misconceptions about a concept and reflect their inner world (Pelton & Pelton, 2009) because they apply subject knowledge and skills to scenarios (Toh, Cheng, Ho, Jiang & Lim, 2017). Therefore, this study showed that asking students creating math-related jokes, cartoons or humor could be used as a way to understand students' conceptualizations of geometry concepts. Thus, we recommend that students and pre-service teachers are given opportunities to create comics and jokes in mathematics lessons and teacher education courses.

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