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Investigation of Mathematics-Themed Rebuses Designed by Prospective Mathematics Teachers[1]

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Abstract: This research aims to investigate the mathematics-themed rebuses designed by prospective mathematics teachers and to reveal how these rebuses are distributed across various themes. The study was conducted using the case study design, one of the qualitative research methods. Sixty-one prospective mathematics teachers studying at a state university in the Western Black Sea Region in Türkiye participated in the research. The data were collected from documents related to the mathematics-themed rebuses designed by the prospective teachers. The collected data were analyzed using content and descriptive analysis techniques. The research findings indicate that the most of prospective mathematics teachers designed their rebuses using computers and rarely opted for the paper-pencil method. A tiny portion of the rebuses designed by the prospective teachers showed the use of spatial positioning, suggesting that the teachers did not sufficiently adopt spatial arrangement strategies in their rebuses. The almost negligible use of texture in the rebuses indicates that the prospective teachers did not fully appreciate the potential of this visual element in their design processes. Additionally, it was found that the most used visual elements in the rebuses were pictures, letters, and symbols, while color and texture were less frequently preferred. When classified according to learning domains, the rebuses were most related to geometry, numbers and operations, and algebra learning domains. This suggests that the prospective mathematics teachers focused particularly on topics where numerical and visual elements are prominent.

Keywords: *Rebus, Intelligence Games, Verbal Intelligence Games, Prospective Teachers*

1. INTRODUCTION

With the rapid advancements in technology, the qualities individuals need to possess have also changed. Today's expectations highlight the ability to produce extraordinary and innovative

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solutions, the skill to implement these solutions quickly, and the mental flexibility required to overcome encountered challenges (Ulusoy, Saygı, & Umay, 2017). The ability to approach every day or planned problems in unconventional ways, evaluate a subject from different perspectives, and propose alternative solutions enables individuals to advance their lives and society (Ministry of National Education [MoNE], 2013). Additionally, the ability to approach every day or planned problems in unconventional ways develops innovative thinking skills and enhances the ability to solve complex problems, providing support in quickly adapting to changing conditions. In this context, various opportunities should be provided to develop individuals' innovative thinking skills and to adapt to the changing world conditions. Foremost among these opportunities are student-centered educational approaches (Özdevecioğlu & Hark Söylemez, 2021).

The primary feature of the curricula used in our current education system is their student-centered nature, which strives to actively engage students in the educational process. Student-centered educational approaches aim for individuals to learn by drawing on their experiences and establishing a personal connection with the topics covered. In this context, it is of great importance to increase students' interest in learning and provide opportunities for them to gain more realistic experiences (Ulaş, 2014). Student-centered learning gives students more control over their own learning processes, thereby increasing their motivation. This approach also helps students develop critical thinking, problem-solving, and independent learning skills (Biggs & Tang, 2011; Hattie & Brown, 2004). One of the methods used in the student-centered approach is teaching through games. In particular, intelligence games have come to the forefront in recent years, actively utilized by many researchers and mathematics educators (Adalar, 2024; Bas, Kuzu, & Gok, 2020; Bayramin, 2020; Dvoryatkina & Simonovskaya, 2021). Intelligence games, with their fun, educational, and engaging materials, help individuals develop cognitive, affective, and psychomotor skills (Çağır & Oruç, 2020).

Intelligence games help students develop cognitive abilities such as problem-solving, reasoning, and using logic (MoNE, 2013). These games make the learning process enjoyable and engaging, thereby increasing students' motivation. Additionally, they enhance students' strategic thinking, attention, and concentration skills. The use of intelligence games in education contributes to students learning abstract concepts in a more concrete and meaningful way (Shute & Ventura, 2013). The literature indicates that intelligence games can enhance students' academic performance. For example, a study by Hamlen Karla (2011) found that strategy-based intelligence games improved students' mathematical problem-solving skills. These types of games not only enhance students' analytical thinking and problem-solving abilities but also boost their self-confidence (Granic, Lobel, & Engels, 2014). Intelligence games, in addition to developing cognitive skills, help students actively participate in the learning process, reducing their stress and anxiety (Sitompul & Juliana, 2020). They also offer opportunities for effective time management and enjoyable leisure time (Kuruoğlu, 2023). The planned and structured implementation of these games positively affects individuals' memory and perception skills (Özdevecioğlu & Hark Söylemez, 2021).

The multiple intelligences theory, which underlies intelligence games, emphasizes that everyone’s intelligence profiles are distinct, and their development is unique (Bottino, Ott &

Tavella, 2013). Corresponding to these differences, intelligence games are divided into six subcategories: verbal games, reasoning and processing games, memory games, geometric-mechanical games, strategy games, and intelligence questions (MoNE, 2013). Based on Gardner's theory of multiple intelligences, these games activate different types of intelligence and individualize learning (Gardner, 1983). In this context, intelligence games contribute not only to academic success but also to social and emotional development, benefit students in aspects such as collaboration and teamwork (Sternberg, 2006). Through these games, students gain confidence and become more actively engaged in the learning process. Among these games, a verbal intelligence game called "rebus" stands out for its ability to reveal different modes of thinking, enhance creativity, and merge knowledge with memory (cited in Yurtoğlu, 2017 by Alkan, Mertol & Mertol, 2020).

Rebuses, with origins tracing back to ancient times, have become popular in our country in recent years. They are defined as puzzles where individuals try to form words, idioms, or proverbs from a mix of pictures, letters, and numbers (Çalış-Zeğerek, 2020). Due to these characteristics, rebus puzzles are considered a junction of imagination and intelligence (Çalış-Zeğerek, 2019). According to Saygın and Saygın (2021), rebus puzzles enhance students' analytical thinking skills, attention levels, and imagination, supporting their concept development and reasoning abilities. Pervaz (2018) states that rebus puzzles develop students' imagination and problem-solving skills, change their perspective on words, and steer them away from rote memorization. Solving puzzles involving words, idioms, and proverbs using pictures, letters, and numbers enhances students' analytical thinking and language skills (Alkan, Mertol & Mertol, 2020). Rebus puzzles are particularly effective in language teaching for expanding students' vocabulary and helping them understand the structure of the language. Ekiçi, Öztürk, and Adalar (2017) state that rebus puzzles not only aid in language learning but also improve students' conceptual understanding in science and mathematics. In mathematics education, rebus puzzles help concretize abstract concepts. Students find it easier to understand concepts related to mathematical symbols and operations, thereby enhancing their mathematical thinking skills (The National Council of Teachers of Mathematics [NCTM], 2000). For example, in a geometry class, rebus puzzles created using shapes and symbols can help students better grasp geometric concepts. Creativity and problem-solving skills are gaining increasing importance in modern education. Rebus puzzles are effective tools in developing these skills. Through rebus puzzles, students explore different ways of thinking and produce creative solutions. This process also develops their analytical thinking skills (Saygın & Saygın, 2021).

Designing rebus puzzles is as significant a learning experience as solving them. The design process stimulates students' creative thinking and enables them to produce original puzzles using their imagination. During this process, students use both analytical and creative thinking skills as they decide which pictures, letters, and numbers to use to represent a specific word, idiom, or proverb. Thus, both solving and designing rebus puzzles support students' cognitive development (Acun & Bektaş, 2019). Çalış-Zeğerek (2019) states that rebus design enhances students' collaboration and communication skills during both individual and group work. In

group settings, students exchange ideas, evaluate each other's perspectives, and strive to reach a common solution. This process strengthens their social skills and teamwork abilities.

Acun and Bektaş (2019) proposed several principles to create an effective learning experience in rebus design. Foremost among these principles is the use of texture, which creates visual depth in rebuses. This helps students better understand concepts by combining tactile learning experiences with visual perception. The use of spatial positioning in rebus design involves the layout of elements on the page. Proper spatial arrangement of pictures, letters, and symbols is essential to clearly convey the intended word or idiom. The diversity of visual elements is also important in rebus design. Acun and Bektaş (2019) emphasize the inclusion of textures and colors in addition to letters, numbers, symbols, and pictures. This variety increases the aesthetic value of rebuses. While rebuses can be designed with computer assistance, incorporating traditional methods like paper and pencil into the creative process can allow students to develop different perspectives. Following these principles, rebus design and rebus solving can support not only creative thinking and problem-solving skills but also mathematical thinking abilities (Çalış-Zeğerek, 2019).

Mathematics education plays a critical role in developing individuals' problem-solving skills, which they will frequently encounter in their lives (Yildiz, Baltacı & Güven, 2011). Therefore, mathematics teachers and prospective teachers bear a significant responsibility in enhancing students' mathematical abilities. It is important to recognize that this responsibility extends beyond merely teaching basic math skills (Granic, Lobel, & Engels, 2014). Mathematics education should not only foster logical thinking skills but also support creative and critical thinking abilities. At this point, it is crucial for mathematics teachers and prospective teachers to be aware of their strategic role in strengthening these skills in students. As emphasized by the NCTM (2000), teachers who are aware of this responsibility can plan and implement their teaching strategies more effectively. This awareness helps teachers not only solve mathematical problems but also enables students to approach and solve problems from different perspectives. This, in turn, maximizes students' mathematical thinking abilities.

Mathematics teachers should recognize the different learning styles and needs of students in the classroom and develop appropriate instructional strategies for them. Effective teaching techniques that facilitate students' understanding and application of mathematical concepts should be continuously updated through teachers' professional development and ongoing education. Additionally, mathematics teachers should provide contextual learning experiences that help students identify and solve real-life situations related to mathematics. Demirel (2015) emphasizes that rebus puzzles are an innovative tool that prospective teachers can use in lesson planning and instructional strategies, highlighting the importance of rebus puzzles. When reviewing research on the use of rebus puzzles in teaching, there are numerous studies on their instructional applications (Duman & Petek, 2023; Yeşilbursa & Işıksal, 2022; Yurteri & Mertol, 2018), but research involving teachers or prospective teachers remains limited. Understanding the impact of tools like rebus puzzles on mathematics education and effectively integrating such tools is a crucial step for teachers and prospective teachers to enhance students' mathematical skills. Therefore, more research is needed to increase teachers' awareness of the use of rebus puzzles and similar tools. These studies can provide guidance on how teachers can

use such tools more efficiently and contribute to the development of innovative practices in mathematics education. In this context, the aim of the study is to investigate the mathematics-themed rebuses designed by prospective mathematics teachers according to various themes. Within this scope, the research problem and sub-problems are presented below:

1.1. Research Problem

The problem of this research is "How is the distribution of the rebuses designed by prospective teachers according to various themes?". In line with this research problem, the sub-problems are as follows:

1. How is the distribution of rebuses designed by prospective teachers according to the theme of "Techniques Used"?
2. How is the distribution of rebuses designed by prospective teachers according to the theme of "Using Spatial Positioning"?
3. How is the distribution of rebuses designed by prospective teachers according to the theme of "Use of Texture"?
4. How is the distribution of rebuses designed by prospective teachers according to the theme of "Visual Elements"?
5. How is the distribution of rebuses designed by prospective teachers according to the theme of "Level of Education"?
6. How is the distribution of rebuses designed by prospective teachers according to the theme of "Learning domain/ subject/ course"?

2. METHODOLOGY

In this study, the case study method, one of the qualitative research approaches, was used. A case study is a research design in which the researcher collects detailed data describing and explaining a specific situation or situations (Creswell, 2013; Yin, 2011). It allows for an in-depth examination of a particular situation or event. In the context of this study, the examined case is related to the analysis of mathematics-themed rebuses prepared by prospective mathematics teachers.

2.1. Participants

The participants of the study consisted of 61 prospective teachers (46 female, 15 male) enrolled in the elementary mathematics teaching program at a state university in the Western Black Sea Region, covering all class levels (4 first-year students, 22 second-year students, 32 third-year students, and 3 fourth-year students). Participation in the research was based on the principle of voluntarism, with only those prospective teachers who were willing to participate being included. Consequently, the number of first- and fourth-year students participating was low, while a significant number of second- and third-year students designed multiple rebuses. As a result, a total of 102 rebuses were obtained from 61 participants. First-year students had limited knowledge of rebuses as they had not yet been involved in any instructional processes or coursework related to rebuses. Their exposure to rebuses was minimal, given that introductory coursework typically focuses on foundational concepts in mathematics education rather than

on advanced instructional strategies like the use of rebuses. Additionally, second-, third-, and fourth-year students can choose elective courses such as intelligence and mind games, while first-year students can't. These students might have already chosen such courses, providing them with more familiarity and experience with rebuses. On the other hand, the fourth-year students were preoccupied with the anxiety related to the Public Personnel Selection Examination (PPSE), which significantly impacted their willingness to engage in additional activities outside of their exam preparations. For ethical reasons, the real names of the prospective mathematics teachers were not used, and they were instead assigned codes such as P1, P2...P61. A convenience sampling method, one of the purposive sampling techniques, was used to select the participants. This method provides the researcher with practicality and speed, as it involves selecting a situation that is close and easily accessible (Yıldırım & Şimşek, 2005).

2.2. Data Collection

In the data collection process, the first step involved informing the prospective teachers about what a rebus is and how it is designed. In the second step, the prospective teachers were asked, "How would you draw mathematics-themed rebuses if you wanted to?" and were allowed to use any technique they preferred (paper and pencil, computer, etc.). In the final step, individual interviews were conducted with the prospective teachers to clarify any unclear points regarding the rebuses they had designed. Accordingly, the research data was collected from documents related to the mathematics-themed rebuses designed by the prospective mathematics teachers.

2.3. Data Analysis

In the analysis of the data, the rebuses were thoroughly examined by the researchers using both content analysis and descriptive analysis methods. The main aim of descriptive analysis is to convey the data obtained from interviews and observations to the reader in an organized and interpreted manner (Yıldırım & Şimşek, 2005). In descriptive analysis, data is classified according to predetermined themes, the findings are summarized, and these summaries are interpreted with the researcher's subjective insights (Baltacı, 2019). Accordingly, each rebus was analyzed according to the rebus preparation principles defined by Acun and Bektaş (2019), including the themes of techniques used, use of spatial positioning, use of texture, and visual elements. Content analysis allows for the objective and systematic detailing of verbal, written, and other materials (Tavşancıl & Aslan, 2001). The main purpose of content analysis is to identify concepts and relationships that can explain the collected data. In content analysis, the collected data is first conceptualized, then logically organized according to these concepts, and finally, themes are identified using these concepts (Yıldırım & Şimşek, 2005). In this phase, the rebuses were examined under the themes of educational level and learning domain/ subject/ course in addition to the rebus preparation principles set by Acun and Bektaş (2019). As a result, the data was analyzed under six themes: level of education, learning domain /subject/ course, techniques used, use of spatial positioning, use of texture, and visual elements. Additionally, to ensure coding reliability, the agreement percentage by Miles and Huberman (1994) was considered, and the reliability percentage was found to be 90%. For the remaining 10% discrepancy, the researchers met and reached full agreement (100%). An example of coding discrepancy among researchers was in the classification under the learning domain

theme: rebuses involving individuals who contributed to mathematics were initially labeled as "Historical Figures" and "Famous Mathematicians." Since these codes could not be integrated under a common theme, the researchers met and agreed on classifying these under the "History of Mathematics" course at the undergraduate level, thus placing them under the Learning Domain/ Subject/ Course theme. In summary, how the data were analyzed according to the six themes is given briefly below.

- *Classification by Technique Used:* This theme involved analyzing whether the rebuses were created using a computer or with paper and pencil.
- *Classification by Use of Spatial Positioning:* This theme involved analyzing whether the rebuses utilized spatial positioning in their design.
- *Classification by Use of Texture:* This theme involved analyzing whether the rebuses incorporated texture in their design.
- *Classification by Visual Elements:* This theme involved analyzing whether the rebuses included numbers, photographs or pictures, letters, colors, and symbols.
- *Classification by Level of Education:* This theme involved analyzing the educational level at which the mathematical words contained in the rebuses were relevant.
- *Classification by Learning Domain/ Subject/Course:* This theme involved analyzing the rebuses according to the learning domains, topics, and courses in the relevant mathematics curriculum.

3. FINDINGS AND INTERPRETATION

In this section, the research data is analyzed according to the sub-problems, and tables showing the frequency distribution of rebuses across six themes are provided. Additionally, graphs created in Excel are included to illustrate the overall distribution for the fourth, fifth, and sixth themes. Furthermore, samples from the rebuses designed by the prospective teachers are presented for each theme.

Table 1. *Frequency Table of Rebuses by Technique Used Theme*

Techniques Used	***f***
Computer	100
Paper and Pencil	2

f: *frequency*

The data presented in Table 1 shows the techniques used in rebus design. Upon examining the table, it is evident that out of 102 rebus designs, 100 were created using a computer, while only 2 were hand-drawn using paper and pencil. This result indicates that the use of computers is more preferred by prospective teachers in rebus designs. As an example of this theme, the rebuses designed by P7 and P11 are shown in Figure 1.

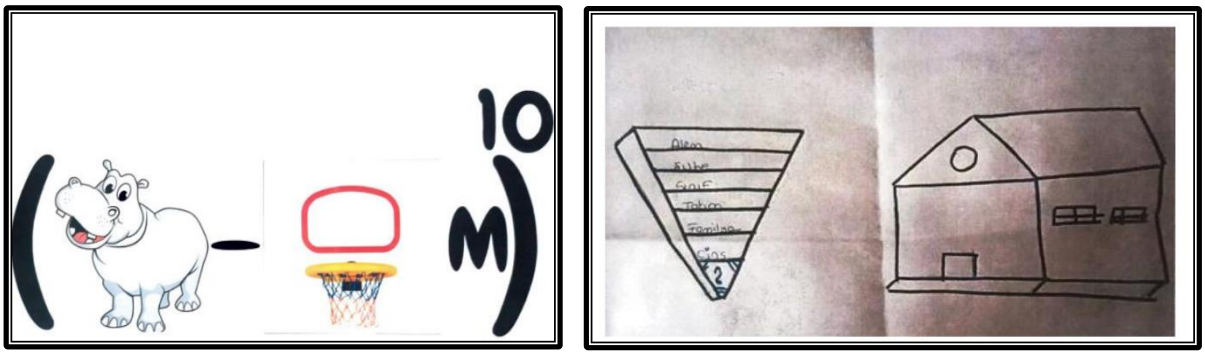


Figure 1. *Rebus Designs by P7 and P11 for the Concepts of Hypotenuse and Derivative*

Table 2. *Frequency Table of Rebuses by Use of Spatial Positioning Theme*

Use of Spatial Positioning	**f**
Using Spatial Positioning	10
Does Not Use Spatial Positioning	92

The data presented in Table 2 shows the use of spatial positioning in rebus designs. Out of a total of 102 rebus designs, spatial positioning was used in 10 designs and not used in 92 designs. This finding indicates that the use of spatial positioning is relatively rare in the rebus designs of prospective mathematics teachers. An example of a rebus design using spatial positioning, created by participant P16, is shown in Figure 2.

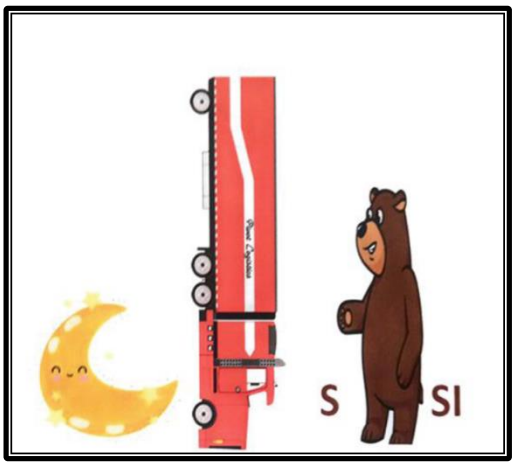


Figure 2. *Rebus Designed by P16 for the Concept of Edge Count*

Upon examining Figure 2, it can be seen that P16 designed a rebus for the concept of "edge count" (ayrıt sayısı) and placed the visual of a "truck" (tır) in a reversed position to represent the syllable "-rıt" in "ayrıt."

Table 3. *Frequency Table of Rebuses by Use of Texture Theme*

Use of Texture	**f**
Using Texture	3
Does Not Use Texture	99

Upon examining Table 3, it is apparent that nearly all prospective teachers did not utilize the technique of using texture. Only three prospective teachers made use of texture in their designs. An example of this, designed by participant P23, is shown in Figure 3.

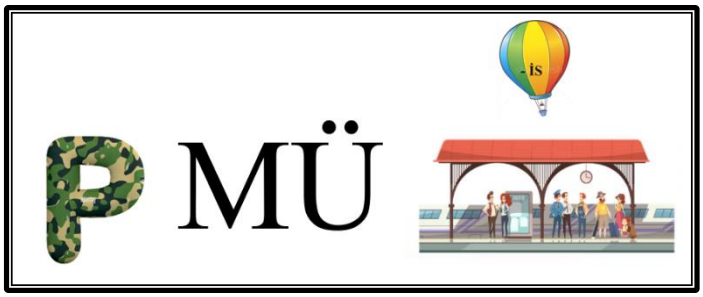


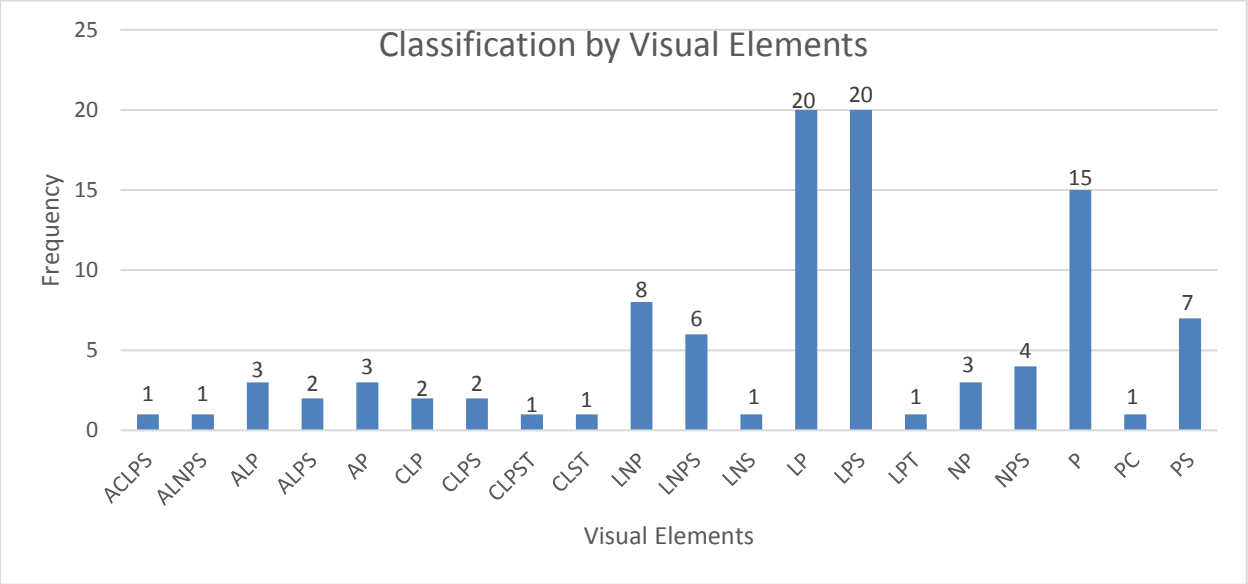
Figure 3. *Rebus Designed for the Concept of Permutation by P23*

Upon examining Figure 3, it can be seen that P23 utilized a military camouflage texture. The prospective teacher incorporated the texture into the letter P for the word "permütasyon" (permutation), creating "P+ER" (ER=soldier) to form the syllable "PER." For the remaining syllables -mü-tas-yon, the teacher directly added the letters MÜ and used an image of a train station (istasyon) to form the syllable -tasyon by removing the syllable –is. This indicates that the participant used a more creative technique by incorporating texture materials compared to other participants. To gain a more detailed understanding of the visual elements used in the rebuses designed by the prospective teachers, Table 4 presents the findings related to the visual elements they employed.

Table 4. *Frequency Table of Rebuses by Visual Elements Theme*

Visual Elements	**f**	**Visual Elements**	**f**
ACLPS	1	LNPS	6
ALNPS	1	LNS	1
ALP	3	LP	20
ALPS	2	LPS	20
AP	3	LPT	1
CLP	2	NP	3
CLPS	2	NPS	4
CLPST	1	P	15
CLST	1	PC	1
LNP	8	PS	7
Total	**102**		

Visual elements are abbreviated as Texture (T), Numbers (N), Photographs or Pictures (P), Letters (L), Spatial Positioning (A), Colors (C), and Symbols (S)

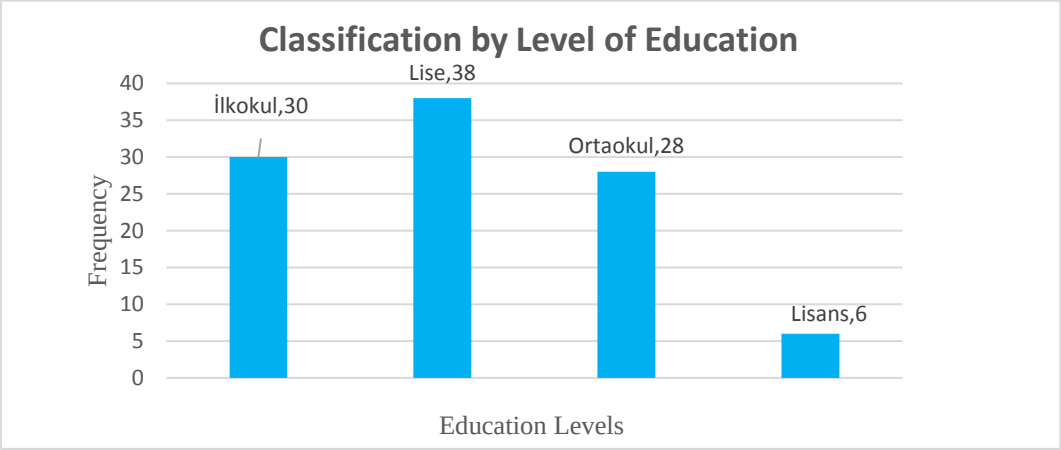


The findings in Table 4 show which visual elements—such as Texture (T), Numbers (N), Photographs or Pictures (P), Letters (L), Spatial Positioning (A), Colors (C), and Symbols (S)—were used in the rebuses designed by the prospective teachers. Additionally, an Excel graph illustrates the overall distribution of these visual elements. Examining the findings in Table 4 reveals that PLS (Photographs or Pictures, Letters, Symbols) and PL (Photographs or Pictures, Letters) have the highest frequencies. The use of PL and P (Photographs or Pictures) is notably widespread. On the other hand, texture, letters, and other combinations have lower frequencies. Overall, it is seen that in the designed rebuses, photographs or pictures were used 100 times, letters 69 times, symbols 46 times, numbers 23 times, colors 8 times, and texture 3 times. These results highlight that prospective teachers particularly prefer using photographs or pictures and letters. Examples of rebuses designed by P4 and P7, which incorporate photographs or pictures and letters, are presented in Figure 4.

Figure 4. Rebus Designs by P4 and P7 for the Concepts of Ruler and Rectangle

Table 5. *Frequency Table of Rebuses by Level of Education Theme*

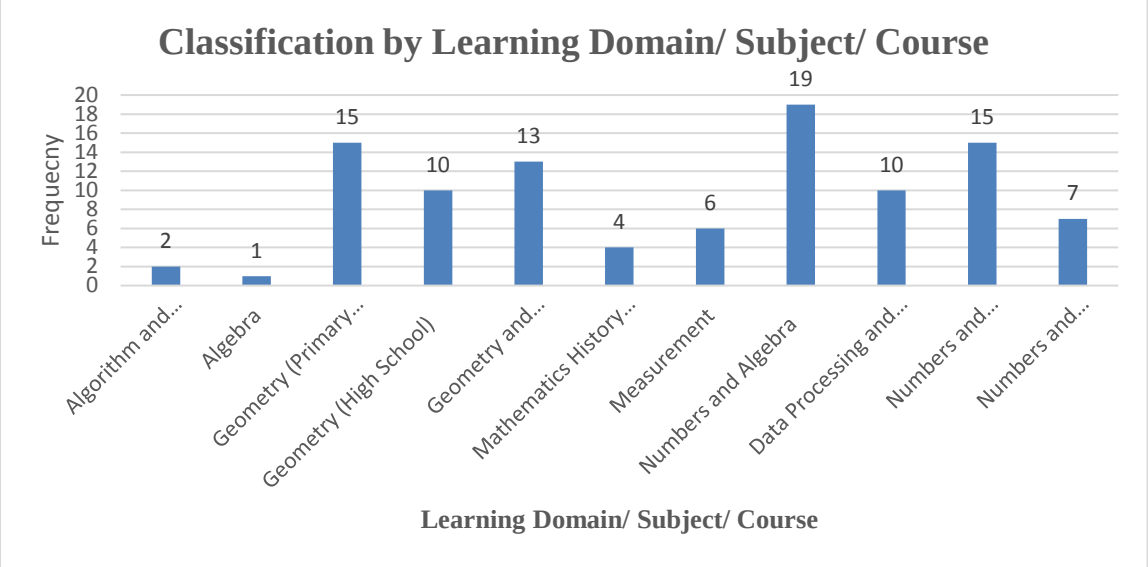
Level of Education	**f**
Primary School	30
Middle School	28
High School	38
Undergraduate	6
Total	**102**



Upon examining Table 5, it is evident that prospective teachers most frequently selected concepts from the high school level for their rebuses, while concepts from the university level were the least selected.

Table 6. *Frequency Table of Rebuses by Learning Domain/ Subject/ Course Theme*

Learning Domain/ Subject/ Course	**f**	**Learning Domain/ Subject/ Course**	**f**
Subject Matter Knowledge Course (Algorithm and Programming)	2	Measurement	6
Algebra	1	Numbers and Algebra	19
Geometry (Primary School)	15	Data Processing and Probability	10
Geometry (High School)	10	Numbers and Operations (Middle School)	15
Geometry and Measurement	13	Numbers and Operations (Primary School)	7
Subject Matter Knowledge Course (Mathematics History)	4		-
Total	**102**		



When the data in Table 6 is examined, it is found that the rebuses designed by the prospective teachers are varied in terms of the learning domain/subject/course theme. Among these learning domains, the highest frequency is in the Numbers and Algebra domain, while the lowest frequency is in the Algebra domain. The specific concepts addressed within this learning domain/ subject/ course theme are detailed in Table 7.

Table 7. *Frequency Table of Concepts in Rebuses*

Concept	**f**	**Concept**	**f**	**Concept**	**f**	**Concept**	**f**
Addition	2	Combination	2	Isosceles Triangle	1	Ruler	1
Adjacent Angle	1	Coordinate	1	Linear	1	Sequences	1
Algorithm	2	Cotangent	1	Logic	1	Set	1
Ali Kuşçu	1	Cube	1	Minuend	1	Sine	1
Al-Jazari	1	Decimal	3	Natural Number	1	Spatial Geometry	1
Analytic	2	Degree	1	Numerical	1	Square	1
Angle Bisector	1	Derivative	1	Parabola	1	Square Prism	2
Angle in a Triangle	1	Diameter	1	Parallelogram	2	Square Root	3
Area	2	Dozen	1	Parameter	2	Statistics	1
Arithmetic	1	Edge	1	Percentages	3	Sudoku	1
Asymptote	1	Edge Count	1	Period	1	Tangent	1
Average	2	Ellipse	1	Permutation	3	Trapezoid	1
Binomial	2	Factor	1	Perpendicularity	1	Triangle	2
Calculus	1	Fifty	1	Plato	1	Trigonometry	1
Cartesian	2	Function	3	Prism	1	Union	1
Cartesian Product	2	Hyperbola	1	Pythagoras	1	Unit Square	1
Certain Event	1	Hypotenuse	1	Quintal	1	Universal Set	1
Chord	1	Integral	2	Rectangle	5	-	-
Circular	1	Intersection	1	Rectangular Prism	1	-	-
Total	27	**Total**	25	**Total**	29	**Total**	21
Grand Total	102						

When examining the findings in Table 7, it is observed that prospective teachers most frequently chose the concept of "rectangle" in their rebus designs. This is followed by the concepts of "percentages," "function," "square root," "decimal," and "permutation." Two examples of rebuses designed for the concepts of "rectangle" and "percentages" are presented in Figure 5.

The rebus designed by P26 represents the word "rectangle" (dikdörtgen) through a combination of visual elements: the 90° symbol signifies a right angle which can be refered as "dik", which is a key feature of rectangles. The letter "d" paired with the covering up (ört) motion implies the Turkish word "dört". The DNA helix subtly hints at "gen," reinforcing the full word "rectangle" (dikdörtgen).

Figure 5. *Rebus Designs by P26 and P32 for the Concepts of Rectangle and Percentages*

4. RESULTS AND RECOMMENDATIONS

The study concluded that prospective teachers were capable of designing mathematics-themed rebuses, but often used similar techniques. This suggests that while the prospective mathematics teachers are proficient in rebus design, they lack diversity and creativity in their techniques. Examples of this include the prospective teachers often neglecting the use of spatial positioning and rarely using texture in their rebus designs, indicating a lack of understanding of the importance of visual elements and spatial layout strategies in the design process. Similarly, their preference for pictures, letters, and symbols over color and texture shows that they do not fully utilize visual elements in their rebus designs. On the other hand, one prospective teacher creatively designed the concept of permutation using the texture theme. This example supports Saygın and Saygın's (2021) view that students can discover different ways of thinking and produce creative solutions through rebuses. This finding indicates that, while most prospective teachers lack diversity and creativity in their techniques, there are instances where they can exhibit innovative thinking. Similarly, Yurtoğlu (2017) emphasized that engaging in rebus activities can reveal various thinking patterns and thus enhance creativity (Alkan, Mertol & Mertol, 2020). Research in the literature indicates that rebuses, described as a junction of imagination and intelligence (Çalış-Zeğerek, 2019). Considering the role of imagination, intelligence, language development, and vocabulary in the development of mathematical thinking, it is important for individuals to benefit from the cognitive power of rebuses. In this context, prospective mathematics teachers should develop and use different techniques to strengthen their rebus designs, which should be considered an innovative approach in teaching. Additionally, the study found that prospective teachers most frequently designed rebuses for high school-level concepts and least frequently for university-level concepts. In terms of learning domains, geometry, numbers and operations were the most common, while algebra was the least common. This suggests that prospective teachers focus more on numbers and pictures or photographs. The reasons behind their less frequent

preference for algebra, measurement, and the history of mathematics in rebus designs could be explored in further research. Activities can be organized for prospective teachers to design rebuses using various techniques to encourage the creation of creative and diverse rebuses (e.g., using texture, spatial positioning). This study focused on the theme of mathematics. Similar studies could explore different themes. Moreover, a similar study could be conducted with teachers or students to compare the results with those of this study. Due to time constraints, this research did not address the difficulties prospective teachers faced in designing rebuses. Future researchers are recommended to conduct detailed studies on the challenges prospective teachers encounter in rebus design.

5. ABOUT THE AUTHORS

Oğuzhan GENÇ: He is a master student in the field of mathematics education. His areas of interest include intelligence games, digital games and virtual reality.

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