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Evaluation of prospective mathematics teachers' perceptions about the concept of intelligent games through metaphors

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Abstract
In this study, it is aimed to examine the perceptions of prospective mathematics teacher about the concept of "intelligent games" through metaphors. Phenomenology method was used in the research. The participants of the research consisted of a total of 218 prospective teachers who studied in Department of Elementary School Mathematics Teacher Program during the spring semester of 2016-2017 academic years. Data of the research are obtained by two sentences in the form of "Intelligent games are like ... because …". Data was analysed by a content analysis method. The statements of prospective teachers starting with "because" were coded. Then relevant codes were united together, and seven categories were developed. Some codes were taken as it is, some were combined and thus, 42 features were formed. At the end of the study, it has been determined that the prospective teachers have produced 143 different metaphors about intelligent games. Besides, it was determined that metaphors, categories, and features concerning intelligent games had a positive meaning in general. In addition, it was seen that perceptions of prospective mathematics teachers centered upon a different category in every grade. Finally, it was concluded that intelligent games were considered a rule, stage, accumulation and outcome oriented concept by female prospective teachers and a concept providing/producing knowledge, solving problems and guiding by male prospective teachers. Metaphors can be used as an important tool in determining and revealing the perceptions of the teachers and students about the concept of intelligent games.

Keywords: Prospective Mathematics Teachers, Intelligent Games, Metaphors, Perception, Phenomenology

Introduction

Mathematics is perceived as a course that is related to numbers, symbols, and calculations and as a tool that is used in every aspect of our daily lives (Umay, 2003). Many concepts in mathematics are unwittingly used in the daily life such as shapes numbers and operations (Tarim & Artut, 2010). The calculation of expected risks and possibilities, the way of perceiving problems, and the solutions for the problems compose the mathematics in daily life (National Council of Teachers of Mathematics [NCTM], 2000). According to the American National Research Council (NRC, 1989), "individuals should know mathematics to join the society fully". Mathematics appears as an important course in terms of developing mathematical thinking skills. The development of mathematical thinking skills are emphasized in the main objectives of the primary and middle school curriculum that has been started to be carried out since 2017 in Turkey (Ministry of National Education [MoNE], 2018). However, it was seen that the teaching activities in schools are not sufficient to provide high-level skills such as mathematical thinking (Lincoln, 2008; Liu & Niess, 2006). Thus, new tools are required to ensure the development of these skills, such as games (Ugurel & Morali, 2010).

A game is an important activity that enables to apply physical and cognitive skills and sustain its existence in terms of education and development (Pehlivan, 2005). A game is a tool for learning life (Tural, 2005) and has an important place in education. While students construct concepts and

relations between concepts as a result of researching, discovering, and questioning by using games, they also use constructive principles such as "learning by living-doing" and "active learning" (Yang, 2012). Learning by games occurs through completion of tasks by the players, provision of knowledge by the game content, the emergence of thinking skills during playing games (McFarlane, Sparrowhawk, & Heald, 2002).

Individuals need thinking skills all the time and everywhere. For this reason, one of the internationally accepted objectives of education is to support and develop thinking skills of individuals (Bottino, Ferlino, Ott, & Tavella, 2007). "Intelligent Games" (IG) are among the type of games that require using thinking skills and provide different perspectives (Marangoz & Demirtas, 2017). The IGs require using strategies in the problem-solving process and help to improve problem-solving skills (Alessi & Trollip, 2001). Furthermore, IGs positively impact academic success (Bottino, Ott, & Tavella, 2013) and mathematical thinking skills of students (Ott & Pozzi, 2012). Due to the fact that students think while they are playing with IGs, student minds become active and comprehend mathematics more easily as they realize that mathematics is a tool (Buyukkececi, 2008). In addition, IGs are defined as brain-education games (Howard-Jones, 2009) that enable learning by having fun through providing concrete and real experiences (Demirel, 2015).

Yang and Chen (2010) determined that pentonimo game improve spatial skills of primary school students. Lin, Shao, Wong, Li, and Niramitranon (2011) revealed that tangram puzzle increases middle school students' beliefs towards problem-solving, improves their cognitive rotating skills and understanding the shapes in the space. On the other hand, Shofan (2014) found out that tangram activities are beneficial in terms of comprehending the concept of field conservation. Devecioglu and Karadag (2014) stated that IGs contribute to the development of affective and psychomotor skills and increase brain power in addition establishing skills such as analysis, synthesis, and cause-effect relationship. Demirel (2015) determined that there is a development in problem-solving skills and academic success of middle school students in the experimental group who were applied IG activities, yet there is no statistically significant difference between experiment and control groups in terms of strategic thinking skills and participation in class. Moreover, it was seen that teacher and student opinions are positive on the impacts of IG activities on students in the same research. Akbas and Baki (2015) also identified that teachers think that IGs contribute to cognitive, affective, and academic development by enabling learning through having fun, practical thinking, improving visual perception, experiencing the ambition and strengthening the memory. Altun, Hazar, and Hazar (2016) determined that IGs improve attention duration of pre-school students. Turkoglu and Uslu (2016) expressed that the cognitive development program related to IGs increase cognitive development of 60-72 months old children. In a similar way, Seb and Bulut-Serin (2017) demonstrated that providing chess-education for 10-14 years old kids positively affect problem-solving skills. In addition, Alkas-Ulusoy, Saygi, and Umay (2017) revealed that majority of the elementary school mathematics teachers think that IGs make positive contributions to the mathematical and affective skills. Marangoz and Demirtas (2017) found out that mechanical IGs improve cognitive skill levels of primary school second-grade students. Alkan and Mertol (2017) stated that parents participate in IG education to spend more quality time with their children in the research they conducted with the parents of children who participate in a science-culture centre. On the other hand, Ekici, Ozturk, and Adalar (2017) determined that prospective social science teachers generally think positively towards IGs and believe in IGs have properties to diversify and enrich education-instruction environment. Finally, Demirkaya and Masal (2017) also reached to the result that the geometrical-mechanical based activities that were implemented in IG course are effective in terms improving students' spatial skills in their study which was conducted with middle school students.

Due to the fact that IGs are effective in development of thinking skills, selective course named as IG was included in the middle school curriculum in the 2012-2013 academic years by MoNE. The IG is accepted as an important course due to the fact that it contributes to the cognitive, socio-emotional,

and psychomotor development of students (Devecioglu & Karadag, 2014). The importance of IG was emphasized in the instruction material prepared by MoNE for middle school mathematics teachers (MoNE, 2016). In the scope of IG, students are expected to have a different perspective in terms of problem-solving, mathematical-logical thinking, and reasoning skills (Kurbal, 2015). "Geometric-mechanical", "verbal" games, "intelligence games"; "memory", "strategy", "reasoning and operation" are included to the content of the IG course (MoNE, 2013). The games such as chess, drafts, sudoku, kendoku, tangram, word hunting are also named as IGs (Mitchell & Savill-Smith, 2004). Simulations, puzzles, action, and adventure games are IGs which are frequently used in education (Connolly, Boyle, MacArthur, Hainey, & Boyle, 2012).

The perceptions of prospective mathematics teachers who will carry out the IG course in the future can form a basis for delivering these courses in a productive way. For this reason, there is a need for detailed information on how prospective mathematics teachers define and explain IG who will implement the IG course, observe students during these courses and evaluate their development. Therefore, it is believed that revealing the perceptions of prospective mathematics teachers on IGs that can affect the development fields of students from various aspects, will contribute to mathematics education and guide researchers who will work on the issue. In addition, this study is considered significant in terms of presenting perceptions of prospective teachers to the literature and also for enabling the formation of new perspectives towards IGs. Presenting the perceptions of prospective teachers towards IGs has a fundamental importance in terms of understanding their vocational implementations better.

Metaphors are one of the ways of understanding perceptions of prospective mathematics teachers towards IGs. The metaphorical perceptions of prospective mathematics teachers can provide a basis for their attitudes and vocational perspectives that they formed with the influence of their pre-vocational education and experience (Guveli, Ipek, Atasoy, & Guveli, 2011). Accordingly, producing and developing positive attitudes and metaphors towards IGs might provide advantages while carrying out the IG course in their professional lives when it is considered that prospective teachers will start to perform their duties in a short time.

One of the main factors that affect the teacher-education process is which perceptions of prospective teachers bring along and how they improved (Culha-Ozbas & Aktekin, 2013). Moreover, the fact that these perceptions are positive and continues to be positive in service is very important for the teachers of the future to be more successful and to raise qualified teachers. Metaphors are used frequently in education in terms of revealing these perceptions (Arik & Benli-Ozdemir, 2016; Beldag & Gecit, 2017). When it is considered that metaphors are mediums that increase success and employing them in education produces positive results, it can be said that the frequency of using metaphors should be increased (Sznajder, 2010). Therefore, metaphors were used to determine the perceptions of prospective mathematics teachers towards the concept of IG in the scope of this study. It is thought that employing metaphors can enhance the subject in terms of determining the perceptions of prospective mathematics teachers towards the concept of IG that can be used as an important tool for developing cognitive, affective, and psychomotor student skills.

A metaphor is attributing a meaning which is different than the accepted meaning to an object, a situation or concept use it in this manner (Deant-Reed & Szokolszky, 1993). A metaphor is an art of reflecting the emotions and thoughts of the inner world to the external world through figurative expressions (Zuniga, 1992). Metaphors are ways of thinking those assist individuals to express themselves and ascribe meanings to the world (Morgan, 1998).

Metaphors have started to be seen as a "pedagogic tools" since individuals can present their perceptions towards an issue and the reasons for their thinking in a wide range through metaphors

(Saban, 2008). In addition, metaphors are regarded as highly functional and strong cognitive tools in understanding an abstract complex or theoretical phenomena (Yob, 2003). Metaphors draw the attention to the implicit features of concepts (Rundgren, Hirsch, & Tibell, 2009). Moreover, metaphors enable individuals to discover the nature and environment, to interpret and experience certain situations that seem senseless (Yildirim & Simsek, 2006).

In the literature, three studies were accessed on game metaphor. Metin-Aslan, Sumer, Taskin, and Emil (2015) found out that secondary school students explain the concept of "game" with 330 metaphors and these metaphors were gathered under 10 categories. On the other hand, Giren (2016) stated that the 36 metaphors were gathered under five categories which were produced by pre-school teachers for the concept of "game for pre-school period child". Hazar, Tekkursun-Demir, and Dalkiran (2017) determined that middle school students explain "traditional game" with 43 metaphors and "digital game" with 65 metaphors. It was also revealed that metaphors related to traditional game were gathered under 10 categories and metaphors related to digital game concept were gathered under 12 categories in this study.
When the literature is reviewed, it is seen that metaphor studies were conducted towards "game", "game for pre-school children", "traditional and digital games". However, there are no research studies on determining metaphors of prospective mathematics teachers on the concept of IG. It is thought that the study will fill the gap in the literature towards revealing the perceptions of prospective mathematics teachers on IGs through metaphors. Furthermore, the current study has an importance as the metaphors will be presented with the reasons and the IG images that appear will be exposed that prospective mathematics teachers have developed towards IG. On the other hand, this study is essential as it gives hints about the perceptions and thoughts towards IG that prospective mathematics teachers will be confronted when they start teaching. Therefore, this study aims to reveal perceptions of prospective mathematics teachers towards IGs through metaphors. In the scope of the study, responses were sought for the questions given below:

1. Under which categories the metaphors that were developed by the prospective mathematics teachers towards IGs are gathered?
2. Under which features the explanations of the prospective mathematics teachers towards IGs are gathered?
3. How is the distribution of the perceptions of prospective mathematics teachers regarding the concept of IGs?

Method

The method of phenomenology was employed in this study. This method focuses on understanding how people attribute meanings to their experiences and how they transform it into consciousness (Patton, 2014). The method of phenomenology aims to comprehend how an individual perceives himself/herself and the external world, emotions, perceptions, and thoughts on reality (Cohen, Manion, & Morrison, 2000). In such kind of studies, a researcher attempts to understand phenomena and events according to the experiences of an individual without adding any concepts or ideas to phenomena and events (Cekmez, Yildiz, & Butuner, 2012). Since, it was aimed to determine the perceptions of prospective mathematics teachers towards the concept of IG through metaphors in this study; the study was carried out by using the method of phenomenology.

Study Group
The study group of the study was formed by using maximum diversity sampling. This sampling is used to demonstrate the diversity of participants who can be the part of the problem that is worked on in the highest way possible (McMillan & Schumacher, 2006). The study group consisted of 218 first, second, third, and fourth-grade students who receive education in Giresun University,

Education Faculty, and Elementary School Mathematics Teacher Program. The perceptions toward IGs may appear according to the experiences with IGs. Therefore, prospective teachers who receive education in the education faculty on IGs or attended a conference were chosen for the study group. The prospective teachers voluntarily participated in the study. In Table 1, information towards the genders and grade levels of the study group was provided:

Table 1. Distribution of participants in terms of genders and grade levels

	1st Grade	2nd Grade	3rd Grade	4th Grade	Total
Female	54	51	35	25	165
Male	13	9	19	12	53
Total	67	60	54	37	218

When Table 1 is examined, it is seen that the number of women prospective teachers is higher in every grade level.

Development and Application of Data Collection Tool

A two-phase form was employed to determine the metaphoric perceptions of prospective mathematics teachers towards IG. In the first phase of the form, two questions were included to determine the genders and grade levels of prospective teachers. In the second phase of the form, there are two sentences on the concept of IG. The data was collected by asking to complete the sentences presented as "IGs are like … because …". As Forceville (2002) states in these sentences, there are three components as a "subject of metaphor", a "source of metaphor", and "features that are attributed from the source of metaphor to its subject". In the sentence of "IGs are like labyrinths", the word "IG" forms the subject of metaphor. Moreover, the concept of "labyrinth" indicates the source of metaphor. In the sentence, "IGs are like labyrinths because the one who follows the right way will reach to the solution", the expression of "because the one who follows the right way will reach to the solution" emphasizes the feature that is attributed from the source of metaphor to its subject.

In the research studies conducted on metaphors, the words "like" is used to address the "subject of metaphor" and "source of metaphor" explicitly (Tasgin & Kose, 2015). The word "because" also presents reasons for metaphors of prospective teachers concerning IGs. The quality and subject to be measured for the semi-structured sentences in the form prepared through examining the studies on metaphors (Erickson & Pinnegar, 2017; Latterell & Wilson, 2016; Ulukok, Bayram, & Selvi, 2015; Vickery, 2018) were discussed with two field experts, ready. Afterwards, a pilot study was conducted with five prospective mathematics teachers from each grade who had been receiving education in the 1st, 2nd, 3rd, and 4th grades with the purpose of reviewing the data collection tool and determining the time given to the study group. In the main implementation, the forms were given to the prospective mathematics teachers to fill. Before the implementation was performed, the prospective teachers were informed about how to fill the data collection tool related to IGs. The prospective teachers produced metaphors towards IGs and made explanations on these metaphors in 15 minutes. The prospective teachers were asked to sit alone to enable them to fill the form without the influence of others. The situation of influencing by others opinions by seeing other responses and exchanging views was prevented in this way. First, the prospective mathematics teachers were asked to complete the sentence "IGs are like …" by associating IGs with a metaphor. Then, the prospective teachers were asked to fill the part that starts with the word "because …". These forms filled by the prospective teachers were employed as the data collection tool. The final version of the form is provided in the appendix.

Data Analysis

The studies that were conducted on metaphors in the literature were examined before the data analysis (Arslan & Zengin, 2016; Gurkan, Ozgun, & Kahraman, 2017; Ma & Gao, 2017; Zhao, Coombs, & Zhou, 2010). As a result of this examination, it was decided to analyse the data step-by-step to

present the data analysis process in detail and guide the way for the researchers who will conduct metaphor analysis for the first time. The data analysis was carried out in five phases. These phases were as (1) "Denotation", (2) "Elimination", (3) "Creating codes, categories, and features", (4) "Providing validity and reliability", and (5) "Calculation of frequency and percentage values". The details of these five steps are explained below in detail.

1. Stage of Denomination: In this step, all of the expressions were transferred to an Excel table created by prospective mathematics teachers created on the concept of IG. Then, some unclear expressions were re-organized through keeping the meaning same and number of created different metaphors were identified. In this process, it was determined that each prospective teacher created a metaphor, yet some metaphors were used by more than one prospective teacher. In this way, a list was formed consisting of 143 metaphors. Finally, the metaphors were defined as concepts which were produced by the prospective teachers.

2. Stage of Elimination: In this step, it was reviewed whether the prospective mathematics teachers expressed the metaphors that they created clearly or not. In this context, the metaphors were reviewed from the perspectives of "subject", "source", and "feature attributed from the source to subject". As a result of this examination, it was decided whether there is any metaphor that should be excluded or not.

3. Stage of Creating Codes, Categories, and Features: The data of this study was analysed by using the content analysis method. In this method, the similar data was gathered under specific concepts and categories (Yildirim & Simsek, 2006). Firstly, the expressions of prospective teachers on IG were gathered under the titles of "source", and "feature attributed from the source to the subject" within the scope of the data analysis. Then, the metaphors of the prospective teachers were investigated through thinking the developing features of IG concepts and participant statements that start with "because" were coded. In terms of coding, the words or word groups were determined that will reflect the prospective teacher explanations and 67 codes were created in total. After the coding process, seven categories were established by gathering the related codes together. Finally, some codes were taken as it is and some of them were combined, in this way, 42 features were formed concerning IGs. The feature is defined by the Turkish Language Association (TLA, 2011, p.1867) as the "quality that enables to differentiate something from others". The codes that were formed by considering this definition and sentenced that were formed by combining these codes were identified as features. Due to the fact that the participants explained certain metaphors in a way to be included in several categories, these metaphors were presented in more than one category. An example that displays how the coding process was conducted and how the features were created is given in Table 2:

Table 2. Coding of a prospective teacher expressions towards IG

Source	Feature Attributed from the Source to the Subject	Coding	Feature
Gymnastic	… because as we do more gymnastics, our bodies also develop more and become more flexible. IGs also enable us to think more flexible ...	IGs enable flexible thinking.	IGs enables flexible (*f*: 1) and systematic thinking (*f*: 1).
Walnut	… because walnuts improve brain. IGs also enable to think systematically by improving brain ...	IGs enable systematic thinking.	

4. Stage of Providing Validity and Reliability: The validity and reliability studies were conducted on researcher formed codes and categories produced by prospective mathematics teachers to assess the status of the representation. In the current study, the data collection and analysis process was

explained in detail to ensure the validity. Furthermore, direct quotations were provided related in the features. If the quotations are long, some words and sentences were removed by not distorting the expression and displayed by triple dots (…). In order to ensure the reliability of the study, the codes formed by the first researcher were given to the second researcher and the consistency of the codes was examined that were produced by two coders. In the process of comparing the codes, the consistency of the codes was determined by identifying the numbers of "agreement" and "disagreement". Coding reliability was determined as 89.0% by using the formula of [Agreement / (Agreement + Disagreement) x 100] (Miles & Huberman, 1994). Then, the researchers were developed 11 categories by a pre-classification of the codes. Later on, the formed codes were presented to two Turkish language teachers and two mathematics instructors to receive their opinions. The categories of "IG as an affective concept" with "IG as a psychomotor concept", "IG as a rule and phase-oriented concept" with "IG as an accumulation based and result-oriented concept", "IG as a concept that highlights individual differences" with "IG as an educative/instructive and necessary concept", "IG as a mixed/complex, mysterious concept" with "IG as a multi-dimensional concept" were combined as a result of the exchange of views with these persons. In this way, the number of categories was decreased to seven and these categories were shown in Table 4. Finally, the reliability calculation was performed. The reliability values between the researchers were found as 87.0% for the codes under the first category, 85.0% for the codes under the second category, 86.0% for the for the codes under the third category, 89.0% for the codes under the fourth category, 91.0% for the codes under the fifth category, 93.0% for the codes under the sixth category, and 95.0% for the codes under the seventh category. Miles and Huberman (1994) stated that the consistency between the researchers should be at least 70.0% in reliability calculations. On the other hand, Creswell (2013) stated that it should be at least 80.0%. Higher than 80.0% reliability calculation indicate a reliable analysis. The researchers were discussed over the codes that were not agreed on, and as a result of this discussion, the codes was included if a consensus was reached on the codes and categories.

5. Stage of Calculation of Frequency and Percentage Values: Finally, the frequency (*f*) values of the features and frequency (*f*) and percentage (%) values of categories were calculated. The obtained data was organized according to the metaphors stated by prospective teachers and developed categories, and tables were formed. The features were presented as straight sentences.

The Role of the Researchers

The researchers informed the prospective teachers about the purpose of the study. In addition, researchers did not display any behaviour that may influence the environment during the data collection process. Finally, researchers presented the findings as they are and put an attention on not reflection their own prejudices on the process.

Results

The 143 metaphors were indicated by the prospective teachers on IG are presented in Table 3:

Table 3. All metaphors formed by the prospective teachers concerning the concept of IG

Metaphors	*f*	%	Metaphors	*f*	%	Metaphors	*f*	%
1.Labyrinth	14	6.4	49.Betting games	1	0.5	97.Reading a poetry book	1	0.5
2.Crosswords	13	6.0	50.Ocean	1	0.5	98.Reading a detective book	1	0.5
3.Playing chess	6	2.8	51.A high mountain	1	0.5	99.Dancing	1	0.5
4.Doing sports	6	2.8	52.Stream bed	1	0.5	100.Fish hunting	1	0.5
5.Puzzle	5	2.3	53.Amazon forests	1	0.5	101.Documentary	1	0.5
6.Brain box	5	2.3	54.Milky Way galaxy	1	0.5	102.Theatre	1	0.5
7.Life	5	2.3	55.Black hole	1	0.5	103.Mall	1	0.5

8.Human brain	5	2.3	56.Liking a four-leaf clover	1	0.5	104.TV shows	1	0.5
9.Mathematical thinking	4	1.8	57.A closed bud	1	0.5	105.Jokes	1	0.5
10.Cracking seeds	4	1.8	58.Snowdrop flower	1	0.5	106.Cartoons	1	0.5
11.Book	3	1.4	59.Rabbit	1	0.5	107.Baby	1	0.5
12.Human	3	1.4	60.Gyrus	1	0.5	108.Behaviours towards games	1	0.5
13.Watch mechanism	3	1.4	61.Activities to improve brain	1	0.5	109.Watch	1	0.5
14.Solving problem	2	0.9	62.Weight lifting and rope jumping of the brain	1	0.5	110.Treasure map	1	0.5
15.Tree	2	0.9	63.Dream	1	0.5	111.Test books	1	0.5
16.Universe	2	0.9	64.Power of thinking	1	0.5	112.Processed gold	1	0.5
17.Walnut	2	0.9	65.Parrot	1	0.5	113.Egyptian pyramids	1	0.5
18.Sun	2	0.9	66.Dog	1	0.5	114.Penny bank	1	0.5
19.Glasses	2	0.9	67.Travelling in the brain parts	1	0.5	115.Making a brain storm	1	0.5
20.Key	2	0.9	68.The relations between our eyes and brain	1	0.5	116.Public Personnel Selection Examination score	1	0.5
21.Football	2	0.9	69.Einstein	1	0.5	117.Ayran from the market	1	0.5
22.Shopping	2	0.9	70.Deadlock	1	0.5	118.Fruit	1	0.5
23.Amusement park	2	0.9	71.Water	1	0.5	119.Sunflower	1	0.5
24.Using the mind	2	0.9	72.Seed	1	0.5	120.Chocolate	1	0.5
25.Improving cognitive skills	2	0.9	73.Light	1	0.5	121.Baking soda	1	0.5
26.Looking for an unknown address alone	1	0.5	74.Perform prayer	1	0.5	122.Computer	1	0.5
27.Raising a child	1	0.5	75.Candle	1	0.5	123.Sewing machine	1	0.5
28.Climbing to trees	1	0.5	76.Poet	1	0.5	124.Ship engine	1	0.5
29.Environment	1	0.5	77.Detective	1	0.5	125.Establishing a computer	1	0.5
30.A new discovery	1	0.5	78.Architect	1	0.5	126.Cooking	1	0.5
31.Hospital	1	0.5	79.Behaviours in the curriculum	1	0.5	127.Sleep	1	0.5
32.Climbing up stairs	1	0.5	80.Numbers that are seen while uploading a program on a computer	1	0.5	128.Freedom	1	0.5
33.War tactics	1	0.5	81.Fitness	1	0.5	129.Knowing the family and relatives	1	0.5
34.Analysing human life	1	0.5	82.Nature sports	1	0.5	130.Meeting with people	1	0.5
35.Creative thinking	1	0.5	83.Fight	1	0.5	131.Friend	1	0.5
36.War	1	0.5	84.Gymnastic	1	0.5	132.Sponge	1	0.5
37.A way to victory	1	0.5	85.Sports braches	1	0.5	133.Black box that hides a rainbow inside	1	0.5
38.Opening a jar	1	0.5	86.Competition	1	0.5	134.Knife sharpener	1	0.5
39.An unsolvable question	1	0.5	87.Mathematical operation	1	0.5	135.Shampoo	1	0.5
40.An acrobat on a rope	1	0.5	88.Geometry questions	1	0.5	136.Opposite side gears	1	0.5
41.Dental braces	1	0.5	89.Non-routine problem	1	0.5	137.Key-lock harmony	1	0.5
42.A cartoon character,	1	0.5	90.Calculator	1	0.5	138.Teared sock	1	0.5

a mouse, reaches the cheese								
43.Turning a pen with one hand	1	0.5	91.Logic	1	0.5	139.Electric circuit	1	0.5
44.Playing with a phone	1	0.5	92.Fourth dimension	1	0.5	140.Buying a shirt from Mavi	1	0.5
45.Sudoku	1	0.5	93.Abacus	1	0.5	141.Vitamin	1	0.5
46.Domino stones	1	0.5	94.Mathematics	1	0.5	142.Tetanus vaccine	1	0.5
47.Folding papers	1	0.5	95.Novel	1	0.5	143.Serum	1	0.5
48.Few players games on computers	1	0.5	96.Reading the favourite novel	1	0.5	Total	218	100.0

When Table 3 is examined, it is seen that the first four concepts that appear in the minds of the prospective mathematics teachers towards IGs are "labyrinth", "puzzle", "playing chess", and "doing sports".

Seven categories were developed by reviewing the expressions of prospective teachers on the concept of IG. These categories were listed by considering the numbers and percentages of participants who expressed the metaphors and presented in Table 4:

Table 4. Categories developed for IG

Categories	*f*	%
1.IG as a cognitive concept	112	51.4
2.IG as an affective and psychomotor concept	41	18.8
3.IG as a concept that requires patience, effort, time, and attention	38	17.4
4.IG as a concept that is mixed/complex, mysterious, and multi-dimensional	37	17.0
5.IG as a concept that is rule, phase, accumulation, and result oriented	27	12.4
6.IG as a concept that highlights individual differences, educative, instructive, and necessary	22	10.1
7.IG as a concept that is informative/productive, problem-solving, and guiding	18	8.3

When Table 4 is considered, it is seen that the category of "IG as a cognitive concept" come to the forefront.

The 70 metaphors are included in the first category named as "IG as a cognitive concept" and the numbers of participants who expressed these metaphors were presented in Table 5 with the percentage values:

Table 5. Metaphors under the category of "IG as a cognitive concept"

Metaphors	*f*	%	Metaphors	*f*	%	Metaphors	*f*	%
1.Crosswords	11	5.0	25.Football	1	0.5	49.Electric circuit	1	0.5
2.Labyrinth	6	2.8	26.Ocean	1	0.5	50.Vitamin	1	0.5
3.Doing sports	6	2.8	27.Calculator	1	0.5	51.Serum	1	0.5
4.Playing chess	5	2.3	28.Amazon forests	1	0.5	52.Activities to improve brain	1	0.5
5.Puzzle	4	1.8	29.Numbers that are seen while uploading a program on a computer	1	0.5	53.Making a brain storm	1	0.5
6.Mathematical thinking	4	1.8	30.Opposite side gears	1	0.5	54.Universe	1	0.5
7.Brain box	3	1.4	31.Tetanus vaccine	1	0.5	55.Poet	1	0.5
8.Life	3	1.4	32.Travelling in the brain parts	1	0.5	56.The relations between our eyes and brain	1	0.5
9.Walnut	2	0.9	33.Sewing machine	1	0.5	57.Sports braches	1	0.5
10.Solving problem	2	0.9	34.Logic	1	0.5	58.Processed gold	1	0.5
11.Sun	2	0.9	35.Knowing the family	1	0.5	59.Knife sharpener	1	0.5

			and relatives					
12.Glasses	2	0.9	36.Non-routine problem	1	0.5	60.Seed	1	0.5
13.Watch mechanism	2	0.9	37.Climbing to trees	1	0.5	61.Tree	1	0.5
14.Human brain	2	0.9	38.Sudoku	1	0.5	62.A way to victory	1	0.5
15.Using the mind	2	0.9	39.Power of thinking	1	0.5	63.Jokes	1	0.5
16.Improving cognitive skills	2	0.9	40.Book	1	0.5	64.Dental braces	1	0.5
17.Human	1	0.5	41.Fruit	1	0.5	65.Novel	1	0.5
18.Stream bed	1	0.5	42.Creative thinking	1	0.5	66.Key-lock harmony	1	0.5
19.Gymnastic	1	0.5	43.Penny bank	1	0.5	67.Looking for an unknown address alone	1	0.5
20.Behaviours in the curriculum	1	0.5	44.Sponge	1	0.5	68.Amusement park	1	0.5
21.Betting games	1	0.5	45.Ship engine	1	0.5	69.Freedom	1	0.5
22.Rabbit	1	0.5	46.Computer	1	0.5	70.Architect	1	0.5
23.Abacus	1	0.5	47.Weight lifting and rope jumping of the brain	1	0.5	Total	112	51.4
24.Reading a detective book	1	0.5	48.Fitness	1	0.5			

When Table 5 is reviewed, it is seen that prospective teachers find IGs similar to the "crosswords" metaphor in this category. The 14 features of the metaphors that consist of the IG category which is a cognitive concept and the quotations regarding these features are presented below:

Feature 1: IGs improve brain/memory (*f*: 42) and perspective (*f*: 8).
"IGs are like sports branch because they improve intelligence and make our muscles work ..."
"IGs are like creative thinking because with IGs our horizons are widened ..."

Feature 2: IGs require thinking skills (*f*: 32) and provide them (*f*: 3).
"IGs are puzzles because you cannot solve them without a deep thinking."
"IGs are like the ways to the victory because they provide thinking skills to people."

Feature 3: IGs are based on logic (*f*: 10) and require using the mind (*f*: 4).
"IGs are like novel ... because novels are establishments ... that are based on logic ... "
"IGs are like brain box because just as a brain box, we need to use our intelligence to solve the IG just as the box ..."

Feature 4: IGs require to use various information at the same time (*f*: 1) and to understand the whole-part relationship (*f*: 11).
"IGs are like using the intelligence because it might be required to use diverse information at the same time in IGs."
"IGs are like puzzles because we should decide where to put which piece. It is also important in IGs to place the pieces appropriately as well."

Feature 5: IGs improve mathematical thinking (*f*: 7) and problem-solving (*f*: 3) skills.
"IG is like sudoku because sudoku also helps to improve mathematical thinking."
"IG is like problem-solving because as we solve more problems, we have more experience in problem-solving ..."

Feature 6: IGs improves reasoning (*f*: 2) and communication skills (*f*: 1).
"IGs are like mathematical thinking because just as mathematical thinking they improve people's reasoning skills and communication skills ..."

Feature 7: IGs enable flexible (*f*: 1) and systematic thinking (*f*: 1).
"IGs are like gymnastics because as we do more gymnastics, our bodies also develop more and become more flexible. IGs also enable us to think more flexible ..."
"IGs are like walnuts because walnuts improve brain. IGs also enable to think systematically by improving brain ..."

Feature 8: IGs accelerate learning (*f*: 1) and make it more permanent (*f*: 1).
"IGs are like tetanus vaccine because we don't realize the benefit of a tetanus vaccine in the first moment but it prevents us from being sick. IGs also look like a game, yet ... they accelerate our learning and make it more permanent."

Feature 9: IGs enable people to become successful in the life (*f*: 2).
"IGs are like the power of thinking because the time that a person allocates for IGs and the power of thinking is in a direct proportion. Most of the brain works with IG and a person's power of thinking increases. This situation leads to success in life."

Feature 10: IGs enable to establish cause and effect relations between events (*f*: 2).
"IGs are like walnuts because both walnuts and IGs keep our minds open and assist us to establish cause and effect relations between events."

Feature 11: Thoughts are freely used in IGs (*f*: 1).
"IGs are like freedom because people use their thoughts with IGs in a free manner."

Feature 12: It is required to think a thought and its opposite at the same time in IGs (*f*: 1).
"IGs are like gears that turn to opposite directions because ... one gear turns to the right and other to left. For this reason, I resemble IGs to a gear to think a thought and its opposite at the same time."

Feature 13: IGs enable us to understand mathematics better (*f*: 1).
"IGs are like dental braces because braces provide an order for teeth in time, and somehow IGs repair the person and help him/her to understand mathematics better."

Feature 14: The consistency should be established in IGs (*f*: 1).
"IGs are like architects because to solve an issue there should be consistency everywhere. This situation is similar to architects as they find consistency everywhere to make a building."

The 34 metaphors are included in the second category named as "IG as an affective and psychomotor concept". The numbers of participants who indicated these metaphors were provided in Table 6 with percentage values:

Table 6. Metaphors under the category of "IG as an affective and psychomotor concept"

Metaphors	*f*	%	Metaphors	*f*	%
1.Cracking seeds	4	1.8	19.Book	1	0.5
2.Shopping	2	0.9	20.Playing with a phone	1	0.5
3.Life	2	0.9	21.Nature sports	1	0.5
4.Amusement park	2	0.9	22.Jokes	1	0.5
5.Football	2	0.9	23.Dancing	1	0.5
6.Crosswords	1	0.5	24.Ayran from the market	1	0.5
7.Reading the favourite novel	1	0.5	25.Abacus	1	0.5
8.Chocolate	1	0.5	26.Mathematics	1	0.5
9.Behaviours in the curriculum	1	0.5	27.Tree	1	0.5
10.Friend	1	0.5	28.A cartoon character, a mouse,	1	0.5

			reaches the cheese		
11.Cartoons	1	0.5	29.Buying a shirt from Mavi	1	0.5
12.Black box that hides a rainbow inside	1	0.5	30.Sleep	1	0.5
13.Liking a four-leaf clover	1	0.5	31.Black hole	1	0.5
14.Watch	1	0.5	32.Meeting with people	1	0.5
15.Reading a detective book	1	0.5	33.Reading a poetry book	1	0.5
16.Doing sports	1	0.5	34.Public Personnel Selection Examination score	1	0.5
17.Dream	1	0.5	Total	41	18.8
18.Documentary	1	0.5			

When Table 6 is examined, it is seen that the most frequently used metaphor is "cracking seeds". The seven features that form the category, IG as an affective and psychomotor concept and quotations regarding these features were provided below:

Feature 1: IGs make individuals like mathematics (*f*: 1) and cause addiction (*f*: 14).
"IGs are like liking four-leaf clovers because only the ones who see the mathematical beauty in a four-leaf clover can like it. Similarly, IGs also lead the ones, who see the beauty inside to like mathematics."
"IGs are like cracking seeds because when we start cracking seeds we cannot stop and want to keep cracking. IGs are also like that. When we start playing we cannot stop it."

Feature 2: IGs are pleasurable (*f*: 12) and add colour to life (*f*: 1).
"IGs are like cracking seeds because it is fun ..."
"IGs are like black boxes that hide a rainbow inside because the ones who see the box do not like it ... but the lives of the ones are coloured who has curiosity and open the box. IGs also colour the life."

Feature 3: IGs make people curious (*f*: 11).
"IGs are like book because book arouses curiosity of an individual ..."

Feature 4: IGs give joy to people (*f*: 8) and make them relaxed (*f*: 2).
"IGs are like chocolate because we cannot stop eating chocolate and we enjoy it every time we taste it ..."
"IGs are like dreams because generally make people very relaxed."

Feature 5: IGs provide people affective (*f*: 1) and psychomotor (*f*: 2) skills.
"IGs are like behaviours in the curriculum because ... through behaviours and IGs ... affective and psychomotor skills can be gained."

Feature 6: Competitor should not be underestimated in IGs (*f*: 1).
"IGs are like football because even you dominate the game ... you should not underestimate ... the competitor until the last moment."

Feature 7: IGs enable people to experience the feeling of losing and winning (*f*: 1).
"IGs are like Public Personnel Selection Examination scores because you can be assigned as much as your score gets higher, and you cannot if your score is low. In IGs, you can win or lose."

The 30 metaphors are included in the third category named as "IG as a concept that requires patience, effort, time, and attention". The numbers of participants who indicated these metaphors were provided in Table 7 with percentage values:

Table 7. Metaphors under the category of "IG as a concept that requires patience, effort, time, and attention"

Metaphors	*f*	%	Metaphors	*f*	%

1.Labyrinth	7	3.2	17.Snowdrop flower	1	0.5
2.Book	2	0.9	18.Mall	1	0.5
3.Crosswords	2	0.9	19.Gyrus	1	0.5
4.Football	1	0.5	20.Amusement park	1	0.5
5.Brain box	1	0.5	21.Test books	1	0.5
6.Fish hunting	1	0.5	22.Climbing up stairs	1	0.5
7.Poet	1	0.5	23.Amazon forests	1	0.5
8.Ayran from the market	1	0.5	24.Liking a four-leaf clover	1	0.5
9.Life	1	0.5	25.Deadlock	1	0.5
10.Looking for an unknown address alone	1	0.5	26.Baby	1	0.5
11.Doing sports	1	0.5	27.A cartoon character, a mouse, reaches the cheese	1	0.5
12.Human brain	1	0.5	28.An acrobat on a rope	1	0.5
13.Sports braches	1	0.5	29.Playing chess	1	0.5
14.Sunflower	1	0.5	30.Improving cognitive skills	1	0.5
15.War	1	0.5	Total	38	17.4
16.Travelling in the brain parts	1	0.5			

When Table 7 is examined, it is seen that the prospective teachers produced the "labyrinth metaphor at most under the category named as "IG as a concept that requires patience, effort, time, and attention". This metaphor is followed by the metaphors "book" and "crosswords" that were produced by two participants for each. The five features that form this category and quotations concerning these features are provided below:

Feature 1: IGs require active participation (*f*: 1) and effort (*f*: 17).
"IGs are like branches of sports because in both of the active participation is necessary to see the positive impact."
"IGs are like books because books are complicated. You read some of them and easily understand but an effort is necessary to understand some of them."

Feature 2: IGs are difficult (*f*: 12) and they take time (*f*: 2).
"IGs are like labyrinths because it is difficult to find the exit ..."
"IGs are like cartoons where a mouse finds the cheese in the labyrinth because ... it takes time to … reach the result ..."

Feature 3: IGs requires to be patient (*f*: 5) and attentive (*f*: 1).
"IGs are like brain box because when I hear on IGs, I think about brain boxes. Making the colours plain requires patience and attention ..."

Feature 4: IGs require to be careful (*f*: 4) and alerted (*f*: 1).
"IGs are like acrobats on a rope because in case of a little mistake the result cannot be reached. We can reach the result if we make it carefully."
"IGs are like football because even if you dominate the game ... you need to be alerted all the time ..."

Feature 5: IGs require making research (*f*: 1).
"IGs are like shopping malls because there are sort of things inside ... We need to make a research to find the shop that we are looking for. We can also reach the right point by making a research."

The 28 metaphors are included in the fourth category named as "IG as a concept that is mixed/complex, mysterious, and multi-dimensional". The numbers of participants who indicated these metaphors were provided in Table 8 with percentage values:

Table 8. Metaphors under the category of "IG as a concept that is mixed/complex, mysterious, and multi-dimensional"

Metaphors	*f*	%	Metaphors	*f*	%
1.Labyrinth	7	3.2	16.Hospital	1	0.5
2.Human brain	3	1.4	17.Milky Way galaxy	1	0.5
3.Playing chess	2	0.9	18.Analysing human life	1	0.5
4.War	1	0.5	19.Fourth dimension	1	0.5
5.Amazon forests	1	0.5	20.Non-routine problem	1	0.5
6.Ayran from the market	1	0.5	21.Opening a jar	1	0.5
7.Candle	1	0.5	22.Gyrus	1	0.5
8.Fish hunting	1	0.5	23.Folding papers	1	0.5
9.Life	1	0.5	24.Establishing a computer	1	0.5
10.Numbers that are seen while uploading a program on a computer	1	0.5	25.Deadlock	1	0.5
11.Book	1	0.5	26.Einstein	1	0.5
12.Universe	1	0.5	27.Behaviours towards games	1	0.5
13.Shopping	1	0.5	28.Fight	1	0.5
14.Watch mechanism	1	0.5	Total	37	17.0
15.War tactics	1	0.5			

When Table 8 is examined, it is seen that the metaphor "labyrinth" comes to the forefront in terms of perceptions of prospective teachers towards IGs with the concepts mixed/complex, mysterious, and multi-dimensional. The metaphor "labyrinth" is followed respectively by "human brain" and "playing chess". The four features formed in this category and quotations concerning these features are provided below:

Feature 1: IGs are complicated/complex (*f*: 19) and include many things inside (*f*: 1).
"IGs are like life because IGs are complicated as life."

Feature 2: IGs require to use various perspectives (*f*: 6), methods, techniques, strategies, or tactics (*f*: 12).
"IGs are like the fourth dimension because there are various perspectives in the fourth dimension. IGs also require using various perspectives ..."
"IGs are like problems which are not routines because we need to understand the data and associate them. Later on, we can use different methods to reach the solution of the problem."
"IGs are like labyrinths because when you repeat the same ways you cannot reach the result easily if you develop new methods, you can reach the results more rapidly."
"IGs are like opening the jars because you need a strategy such as taking the air inside to open the jar ... and for IGs you may also need to define a particular strategy."
"IGs are like playing chess because they include different strategies."

Feature 3: IGs have undiscovered aspects (*f*: 3).
"IGs are like the human brain because they have many undiscovered aspects ..."

Feature 4: In IGs, many games can be won with one method (*f*: 1).
"IGs are like folding papers because in paper folding, many shapes can be created through one method. In IGs, many games can be won with one method."

The 20 metaphors are included in the fifth category named as "IG as a concept that is rule, phase, accumulation, and result oriented". The numbers of participants who indicated these metaphors were provided in Table 9 with percentage values:

Table 9. Metaphors under the category of "IG as a concept that is rule, phase, accumulation, and result oriented"

Metaphors	*f*	%	Metaphors	*f*	%
1.Labyrinth	7	3.2	12.Teared sock	1	0.5
2.Crosswords	2	0.9	13.An unsolvable question	1	0.5
3.Perform prayer	1	0.5	14.Detective	1	0.5
4.Cooking	1	0.5	15.Geometry questions	1	0.5
5.Life	1	0.5	16.Puzzle	1	0.5
6.Sewing machine	1	0.5	17.Raising a child	1	0.5
7.Competition	1	0.5	18.A high mountain	1	0.5
8.Treasure map	1	0.5	19.Watch	1	0.5
9.Mathematical operation	1	0.5	20.Environment	1	0.5
10.Mall	1	0.5	Total	27	12.4
11.Playing chess	1	0.5			

When Table 9 is examined, it is seen that prospective teachers found the metaphor "labyrinth" for IGs at most. The four features that form this category and quotations concerning these features are provided below:

Feature 1: IGs have certain rules (*f*: 12).
"IGs are like competitions because they aim to reach a goal. They have certain rules."

Feature 2: In IGs, a result is reached with certain moves (*f*: 6), operations (*f*: 1) or hints (*f*: 4) in a progressive way.
"IGs are like labyrinths because you cannot reach the exit without using your mind. You should make accurate and logical moves so that you can reach the exit."
"IGs are like mathematical operations because during IG you can reach the results by applying certain operations in a progressive way."
"IGs are like geometry questions because they include hints inside and with this hints result can be reached."

Feature 3: IGs require experience (*f*: 4).
"IGs are like playing chess because there is experience in chess ..."

Feature 4: In IGs, the moves are made according to the result (*f*: 2).
"IGs are like raising children because you know the result of an IG. You make a move according to the result you know or move towards the result you want to go. Raising children is also like that …"

The 22 metaphors are included in the sixth category named as "IG as a concept that highlights individual differences, educative, instructive, and necessary". The numbers of participants who indicated these metaphors were provided in Table 10 with percentage values:

Table 10. Metaphors under the category of "IG as a concept that highlights individual differences, educative, instructive, and necessary"

Metaphors	*f*	%	Metaphors	*f*	%
1.Book	1	0.5	13.Crosswords	1	0.5
2.Turning a pen with one hand	1	0.5	14.Jokes	1	0.5
3.TV shows	1	0.5	15.Liking a four-leaf clover	1	0.5
4.A new discovery	1	0.5	16.Abacus	1	0.5
5.Parrot	1	0.5	17.Human	1	0.5
6.Dog	1	0.5	18.Playing chess	1	0.5
7.Light	1	0.5	19.Baking soda	1	0.5
8.Buying a shirt from Mavi	1	0.5	20.Water	1	0.5

9.Opening a jar	1	0.5	21.Baby	1	0.5
10.Brain box	1	0.5	22.Glasses	1	0.5
11.Few players games on computers	1	0.5	Total	22	10.1
12.Domino stones	1	0.5			

It is understood from Table 10 that prospective mathematics teachers do not concentrate on a particular concept in the IG category as an educational, instructive, and necessary concept, which emphasizes individual differences, and that they each refer to a different concept of IGs. The four features of the metaphors that form this category and quotations concerning these features are provided below:

Feature 1: IGs required to be talented (*f*: 1) and have a certain intelligence level (*f*: 11).
"IGs are like turning pencils with one hand because not every person can do that. It means that IG requires intelligence and talent ..."
"IGs are like buying shirts from Mavi because Mavi is a very expensive shop so someone who does not have money cannot buy a shirt from Mavi. For a one who does not have a certain intelligence level, IGs are difficult."

Feature 2: IGs are educative (*f*: 1), instructive (*f*: 5), and necessary (*f*: 2).
"IGs are like book because books are like educative and instructive."
"IGs are like baking soda because it is necessary to bake a cake. IGs are important to improve the brain."

Feature 3: IGs are cute (*f*: 1) for some and bothering (*f*: 3) for others.
"IGs are like babies because IGs are cute as babies ..."
"IGs are like glasses because ... you can see clearly with glasses but it is bothering to carry it all the time."

Feature 4: IGs draw the attention of a few conscious people (*f*: 2).
"IGs are like games with fewer players on computers because there are games with few players ... IGs are like them. They consist of fewer players yet conscious ones."

The 16 metaphors are included in the seventh category named as "IG as a concept that is informative/productive, problem-solving, and guiding". The numbers of participants who indicated these metaphors were provided in Table 11 with percentage values:

Table 11. Metaphors under the category of "IG as a concept that is informative/productive, problem-solving, and guiding"

Metaphors	*f*	%	Metaphors	*f*	%
1.Sun	2	0.9	10.Fourth dimension	1	0.5
2.Key	2	0.9	11.Theatre	1	0.5
3.Human	1	0.5	12.Human brain	1	0.5
4.A new discovery	1	0.5	13.Book	1	0.5
5.Sports braches	1	0.5	14.A closed bud	1	0.5
6.Labyrinth	1	0.5	15.Creative thinking	1	0.5
7.Watch mechanism	1	0.5	16.Egyptian pyramids	1	0.5
8.Shampoo	1	0.5	Total	18	8.3
9.Candle	1	0.5			

When Table 11 is examined, it is seen that prospective teachers associate IGs with the metaphors "sun" and "key". The four features of the metaphors that form this category and quotations concerning these features are provided below:

Feature 1: IGs enable the emergence of new ideas or opinions (*f*: 8).

"IGs are like keys because each right key opens a door to a new space ... IGs are also like that. New information can be found by trying."
"IGs are like thinking creatively because with IGs ... we can discover new ideas on an issue or event."

Feature 2: IGs produce different solutions (*f*: 5).
"IGs are like labyrinths because as there is only one exit in a labyrinth and different ways, there is a different solution in IGs."

Feature 3: IGs purify the brain from unnecessary thoughts (*f*: 1) and guide people (*f*: 4).
"IGs are like shampoos because we clean the bad, useless, unnecessary thoughts with IGs."
"IGs are like the sun because the sun lightens our way, warms us, let the plants grow. Lighten us at night by giving its light to the moon. IGs also guide us ..."

Feature 4: IGs give people information or messages (*f*: 1).
"IGs are like theatres because they have a specific script and an information or message is provided to the audience."

The comparison of the categories regarding the IG concept according to genders is provided in Table 12:

Table 12. The comparison of the categories regarding the IG concept according to genders

Categories	Female		Male		Total	
	f	%	*f*	%	*f*	%
1.IG as a cognitive concept	88	78.6	24	21.4	112	100.0
2.IG as an affective and psychomotor concept	30	73.2	11	26.8	41	100.0
3.IG as a concept that requires patience, effort, time, and attention	28	73.7	10	26.3	38	100.0
4.IG as a concept that is mixed/complex, mysterious, and multi-dimensional	24	64.9	13	35.1	37	100.0
5.IG as a concept that is rule, phase, accumulation, and result oriented	25	92.6	2	7.4	27	100.0
6.IG as a concept that highlights individual differences, educative, instructive, and necessary	16	72.7	6	27.3	22	100.0
7.IG as a concept that is informative/productive, problem-solving, and guiding	10	55.6	8	44.4	18	100.0

When Table 12 is reviewed, it is seen that female prospective mathematics teachers adopt IGs mostly as a concept of "rule, phase, accumulation, and result-oriented" while males adopt it as a concept of "informative/productive, problem-solving, and guiding". The comparison of the categories regarding the IG concept according to grade levels is provided in Table 13:

Table 13. The comparison of the categories regarding the IG concept according to grade levels

Categories	1st Grade		2nd Grade		3rd Grade		4th Grade		Total	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
1.IG as a cognitive concept	37	33.0	27	24.1	31	27.7	17	15.2	112	100.0
2.IG as an affective and psychomotor concept	9	22.0	18	43.9	6	14.6	8	19.5	41	100.0
3.IG as a concept that requires patience, effort, time, and attention	13	34.2	8	21.1	10	26.3	7	18.4	38	100.0
4.IG as a concept that is mixed/complex, mysterious, and multi-dimensional	13	35.1	8	21.6	7	18.9	9	24.3	37	100.0
5.IG as a concept that is rule, phase, accumulation, and result oriented	9	33.3	6	22.2	10	37.0	2	7.4	27	100.0
6.IG as a concept that highlights individual differences, educative,	6	27.3	4	18.2	9	40.9	3	13.6	22	100.0

instructive, and necessary										
7.IG as a concept that is informative/productive, problem-solving, and guiding	7	38.8	3	16.7	5	27.8	3	16.7	18	100.0

According to the information in Table 13, the first graders mostly adopt IG as a concept that is informative/productive, problem-solving, and guiding. The second graders adopt IG as a concept that is "affective and psychomotor". The third graders adopt IG as a concept that "highlights individual differences, educative, instructive, and necessary". The fourth graders adopt IG as a "mixed/complex and mysterious concept".

Discussions, Conclusions, and Suggestions

The following conclusions were drawn in this study which aimed to gather the metaphors under categories towards IG developed by the prospective mathematics teachers, state the expressions as features, and investigate distribution of the perceptions in terms of genders and grade levels.

It was determined that many metaphors are needed to explain the IG concept in an integrative way. In this study, it was determined that prospective mathematics teachers produced 143 different metaphors. This situation demonstrates that the concept of IG cannot be explained by one metaphor. Yob (2003) stated that although metaphors provide strong perspectives for the aforementioned concepts, there can be a need for many metaphors. In this way, Metin-Aslan et al. (2015) determined that high school students explain the concept of "game" with 330 metaphors; Giren (2016) stated that pre-school teachers explained the concept of "game for pre-school period child" with 36 metaphors, and Hazar et al. (2017) indicated that middle schools students explain "traditional game" with 43 metaphors, and "digital game" with 65 metaphors. In addition, the metaphors demonstrate that prospective teachers have certain awareness on IGs. It is pleasing that the prospective teachers who have not started their professional life to have awareness towards IGs. It is thought that receiving courses on IGs or providing conferences for prospective teachers lie behind this awareness. By enabling prospective teachers to interpret the metaphors that they created towards IGs, how they ascribe meanings to the IG concept can be understood better. In this way, the concepts can be determined and necessary feedbacks and corrections can be provided on inadequate or inaccurate learning of prospective teachers. In addition, metaphors of prospective mathematics teachers who have never receive a selective course on IGs or attend a conference can be determined and compared with the metaphors in this study.

It was revealed that the mostly produced metaphors by the prospective mathematics teachers are "labyrinth", "crosswords", "playing chess", and "doing sports". While participants explain these metaphors, they emphasize that IGs improve brain/intelligence and require thinking skills. Buyukkececi (2008) stated that student mind become active while they are thinking during IGs. Ott and Pozzi (2012) also realized that IGs can improve cognitive functions by enabling the brain to exercise and make brain gymnastics. The obtained metaphors in the scope of the research are the hints that show how the concept of IG is perceived by the prospective mathematics teachers. For this reason, metaphors can be used to discover the perceptions towards any concept regarding mathematics education.

It was seen that various categories are needed to explain the concept of IG. In the current study, various categories were required to reveal the whole picture of the perceptions of prospective teachers towards IGs. In this study, it was found that expressions of prospective mathematics teachers concerning the concept of IG are gathered under seven different categories. This situation demonstrates that the perceptions towards the concept of IG are multidimensional and various. It is thought that the different perceptions of prospective mathematics teachers towards IGs arise from the

fact that the scope of the IG concept is wide and complex. In a similar way, Metin-Aslan et al. (2015) gathered the metaphors of the high school students about the concept of "game" in 10 categories, and Giren (2016) determined that the metaphors were gathered under five categories which were produced by pre-school teachers for the concept of "game for pre-school period child". Moreover, Hazar et al. (2017) explained the metaphors of middle school students about "traditional game" in 10 categories and about "digital game" in 12 categories. In addition, when all of the categories are considered, it was seen that prospective teachers generally have a positive attitude towards the concept of IG. These categories that were developed in the scope of the research can be used in scales and surveys that will be developed on IGs.

When the categories for the IG concept examined, it was revealed that the most included metaphor category was "IG as a cognitive concept". This category was followed by "IG as an affective and psychomotor concept" category. From this perspective, it can be primarily said that thoughts of prospective teachers on IG are related to the cognitive field. When the codes related to IGs are examined, it is seen that the prospective teachers made more explanations on the cognitive aspect of IGs. Similarly, it was stated in the literature that (Akbas & Baki, 2015; Alkas-Ulusoy et al., 2017; Devecioglu & Karadag, 2014) IGs are very important for the healthy development of individuals as it provides cognitive, affective, and psychomotor development. When learning is considered as an accumulative process that forms the basis for learnings in cognitive, affective, and psychomotor fields, it is suggested to put an emphasis on metaphors in every education level (Goodman, 2003).

According to the research findings, another metaphor produced category was the category named as "IG as a concept that requires patience, effort, time, and attention". Since some IGs are abstract and difficult, prospective teachers may confront difficulties in terms of perceiving IGs. In a similar way, Ekici et al. (2017) determined that prospective social sciences teachers consider IGs as difficult, and time-consuming and costly activities. The most effective way to eliminate this situation is the participation of prospective teachers in activities and events frequently. In addition, faculty members of education faculties have an important role in terms of encouraging prospective teachers to participate in activities related to IGs as symposiums and seminars.

Another category that emerged according to the research results is "IG as a mixed/complex, mysterious concept". According to this category, it might be reached to the result that prospective teachers also have negative perceptions towards IGs. The reasons for these negative perceptions of the prospective teachers might be the confronted difficulties while they are playing an IG or lack of knowledge towards IGs. In order to eliminate or facilitate this situation, selective or must course can be provided in mathematics teaching programs. These courses may assist prospective teachers to learn about new IGs, become familiar with the basic concepts of IGs and to prepare activities. In the updated primary and middle school curriculum (MoNE, 2018), the learning objectives are frequently emphasized which are also included in the main objectives of IGs such as problem-solving, strategy-developing, reasoning, analysing, interpreting, and evaluating. It is suggested for prospective mathematics teachers to put an emphasis on selective IG course to enable their students to reach these objectives when they become teachers.

Some of the prospective teachers perceived IGs as an activity that has certain rules and phases, direct to a result and require experience. This situation demonstrates itself in the category, "IG as a concept that is rule, phase, accumulation, and result oriented". In the literature, there are any similar studies were found to discuss this category. IGs have certain rules and phases. It is necessary to have experience on IGs to learn, apply, and reach the result. The places where this experience can be earned are education faculties and schools. In the scope of special learning methods, mathematics teaching and selective IG courses will be beneficial to enable prospective teachers to prepare study sheets and to apply these materials to the teaching implementations in terms of gaining experience. In

this way, prospective teachers will have the opportunity of observing the positive and negative aspects of IGs through these implementations.
Another category that was created towards IGs is "IG as a concept that highlights individual differences, educative/instructive, and necessary concept". From this category, it is understood that the prospective teachers perceive the concept of IG as a valuable and necessary tool for education and instruction. From this point of view, it can be said that the prospective teachers are aware that IGs are appropriate learning tools and provide an opportunity for learning. In a similar way, there are studies in the literature (Giren, 2016; Tugrul, Metin-Aslan, Erturk, & Ozen-Altinkaynak, 2014) indicates that the pre-school teachers expressed games have educative and instructive aspects. There are actions such as "developing problem-solving skills (Alessi & Trollip, 2001; Kurbal, 2015)", "developing mathematical thinking skills (Ott & Pozzi, 2012)", and "establishing empathy and thinking through different perspectives (Akbas & Baki, 2015)" while playing IGs. Due to these reasons, IGs have to be an important component of mathematics teaching programs.

When the metaphors of prospective teachers and the sentences that they used to explain these metaphors are taken into consideration, it is seen that IGs emphasize the functions of guiding, informing, and providing solutions. This situation displays itself in the category of "IG as an informative/productive, problem-solving, and guiding concept". Individuals use their thinking skills while they are solving the confronted problems and creating new knowledge or ideas. In this process, IGs play an important role. Because IGs help individuals to decide precisely and rapidly, realize their own potential, renew them constantly, and produce solutions against the problems (Seb & Bulut-Serin, 2017). For this reason, it is important for academicians to provide detailed information about the importance of IGs to the prospective mathematics teachers in daily life, or in solving mathematical problems. In this context, environments should be prepared that will increase the success of prospective mathematics teachers in IGs and improve their positive attitude towards IGs.

It was found out that IG perceptions of female and male prospective mathematics teachers have two different orientations. Females are more interested in the functioning of the IG concept and its results, and they attend to define IGs as "rule, phase, accumulation, and result oriented" concepts. On the other hand, males address IGs as a concept which is "informative/productive, problem-solving, and guiding". Metin-Aslan et al. (2015) determined the game metaphors included categories as differentiating according to genders. The differences between females and males can be seen as the reason for this situation. In this context, it is thought that conducting research studies on IGs perceptions of students in different grade levels, mathematics teachers and academics can contribute valuable knowledge to the literature.

In the analysis that was conducted by considering the grade levels, it was determined that the prospective teachers who receive education in the first, second, third, and fourth grades have four different orientations. IG was defined by the first graders as "informative/productive, problem-solving, and guiding", by the second graders as "affective and, psychomotor", by the third graders it was defined as "a concept that highlights individual differences, educative, instructive, and necessary" and by the fourth graders as "mixed/complex, mysterious, and multidimensional". Metin-Aslan et al. (2015) also revealed that the included categories that game metaphors are differentiate according to the grade levels. One of the important sources of perceptions is self-learning experiences of teachers (Richardson, 2003). Prospective teacher experiences on IGs may affect their perceptions towards IGs. Changes may occur in IG perceptions of prospective mathematics teachers in time. Prospective teachers can create new perceptions by means of the situations and confronted phenomena (Tortop, 2013). It can be said that the courses that prospective mathematics teachers receive during their undergraduate education and the experiences they gained concerning mathematical thinking and problem-solving also have an impact on these differences. In order to

understand that, qualitative and quantitative studies can be conducted which may provide more detailed information.

Briefly, this study presents the perceptions of prospective teachers towards IGs. The findings of the study can be used in the process of raising prospective mathematics teachers. The emerged metaphors, codes, categories, and features in the study can form a source for researchers towards IGs. In order to develop positive attitudes towards IGs, prospective mathematics teachers should have knowledge on IGs. Therefore, it might be beneficial for researchers who consider working on the effectiveness of IGs to provide information to individuals on IG implementations, and later to design and lead the activities towards IGs that will increase the motivation of teachers and students. Furthermore, it is suggested to develop the activities and study sheets that were designed by academics and use them in the lectures. Metaphors towards the concept of IG can be revealed produced by students in different age groups, mathematics teachers, academics in the department of mathematics, or students and parents. Finally, the perceptions of mathematics teachers who perform their duties on IGs can be examined and compared with the perceptions of prospective mathematics teachers.

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Appendix

Data Collection Tool Used in the Study
( ) Female ( ) Male
( ) 1st Grade ( ) 2nd Grade ( ) 3rd Grade ( ) 4th Grade

Intelligent games are like ..... because .....
……..….....……
……..….....…