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Perspectives of Education Faculty Students on Creative Teacher and Creative Learning Environment

Eğitim Fakültesi Öğrencilerinin Gözünden Yaratıcı Öğretmen ve Yaratıcı Öğrenme Ortamı [1]

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Abstract

Purpose: This study aims to examine students in the field of science teaching perspectives of creative science teachers and creative science learning environments that will improve students' creative thinking skills and creativity through written and visual metaphors.

Participants consist of 1st, 2nd, 3rd, and 4th-grade 247 students in the field of science teaching who voluntarily participated in the study during the spring semester of 2021-2022 at three state universities in Turkey.

Design/Methodology/Approach: The study was designed in accordance with the qualitative research approach. In order to determine the metaphors of students, hold about the concepts of "creative science teacher" and "creative science learning environment" a form was used. In the first section of the form, respondents were asked to complete "Creative science teacher is similar to..... because....." and "Creative science learning environment is similar to..... because....." sentences. In the second part of the form, students were asked to draw the creative science learning environment and creative teacher in the science lesson. The data obtained from the forms were subjected to content analysis.

Findings: Based on the findings obtained from the study, it was determined that the students produced the most laboratory metaphors for the creative science learning environment, and the most frequently used object in their drawings was laboratory material. It was observed that the students were shown to generate the greatest number of scientists metaphors for creative science teachers and it is determined that their metaphors changed according to their grade level.

Highlights: It can be suggested to investigate the factors that cause the differences in the students' perspectives on creativity.

Öz

Çalışmanın amacı: Bu çalışmanın amacı, fen bilgisi öğretmenliği bölümünde öğrenim gören öğrencilerinin yaratıcı fen öğrenme ortamı ve yaratıcı fen öğretmenine yönelik algılarının yazılı ve görsel metaforlar aracılığı ile incelenmesidir.

Çalışmanın örneklemini 1., 2., 3. ve 4. sınıfta öğrenim gören 247 öğrenci oluşturmaktadır.

Materyal ve Yöntem: Bu çalışmada katılımcıların olayları, olguları tümevarımcı bir yaklaşımla nasıl tanımladığını ortaya çıkarmak ve bakış açılarını anlamak hedeflendiğinden çalışma nitel araştırma yaklaşımına uygun olarak yürütülmüştür. Öğrencilerin "yaratıcı fen bilgisi öğretmeni" ve "yaratıcı fen öğrenme ortamı" kavramı ile ilgili zihinlerindeki metaforları belirlemek amacıyla 'Yaratıcı Öğrenme Metaforum' olarak adlandırılan bir form geliştirilmiştir. Formun ilk bölümünde "Yaratıcı fen bilgisi öğretmeni .....'ya benzer çünkü ...." ve "Yaratıcı fen öğrenme ortamı .....'ya benzer çünkü ....." cümlelerini öğrencilerin kendi düşünceleri doğrultusunda tamamlamaları istenirken, ikinci bölümünde ise fen dersinde yaratıcı düşünme becerilerini geliştireceğini düşündükleri, yaratıcı fen öğrenme ortamını ve öğretmenini çizerek anlatmaları istenmiştir. Formlardan elde edilen veriler içerik analizine tabi tutulmuştur.

Bulgular: Çalışmadan elde edilen bulgulara dayalı olarak ise öğrencilerin yaratıcı fen öğrenme ortamına yönelik en fazla laboratuvar metaforunu ürettikleri ve çizimlerinde ise en sık yer verdikleri nesnenin laboratuvar malzemesi olduğu belirlenmiştir. Öğrencilerin yaratıcı fen bilgisi öğretmenine yönelik olarak ise en fazla bilim insanı metaforunu ürettikleri görülmüştür. Ayrıca, öğrencilerin metaforlarının sınıf seviyelerine göre farklılık gösterdiği belirlenmiştir.

Önemli Vurgular: Öğrencilerin yaratıcılığa bakış açılarındaki farklılıklara sebep olan faktörlerin araştırılması önerilebilir.

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INTRODUCTION

Today, creativity is one of the key qualities that people are expected to exhibit. Creativity can be defined as the ability to develop novel solutions to issues (Runco, 1994) and break out of existing patterns (Rıza, 2006). Curriculum and learning environments have a significant role in the development of creativity (Topoğlu, 2015). In this context, schools should equip students with creativity, innovation, and entrepreneurship skills for the future (Learning & Teaching Scotland, 2007). Therefore, countries are revising their curricula to incorporate these skills.

By its very nature, science education lends itself to inquiry, questioning, and imagination. Individuals who can use their creativity can produce innovative solutions to the problems they encounter in daily life by using the scientific knowledge they have acquired through science education (Koray, 2003). For this reason, science emerges as one of the essential learning areas that can be effective in fostering creativity (Daud, Omar, Turiman & Osman, 2012). It is known that creative thinking was incorporated into the national curriculum in 2013 (MEB, 2013). Creative thinking skill, which is included in the curriculum as one of the life skills, also takes place in the most recent curricular change made in 2024 (MEB, 2024).

Creativitiy can be taught and nurtured (Piirto, 2021). Teachers with creative personality traits have a significant impact on the growth of students' creativity (Senemoğlu, 2018). In addition, the environment in which learning takes place is another essential element that has an influence on the development of creative thinking skills. Also, a significant relationship exists between the learning environment and the learning outcome (Bland & Sharma Brymer, 2012). The development of creativity can, thus, be assisted by creative teachers who can establish a novel, engaging, and stimulating learning environments (Arrington, Moore & Bagdy, 2021; Kranyik & Bartlett, 1965).

For science teachers to cultivate creative thinking skills in their students, they must first possess creative teacher characteristics and be able to design science learning environments that can enhance students' creative thinking skills (Chan & Yuen, 2014). In this regard, Baghetto and Kaufman's (2014) study show that teachers care about fostering their students' creativity; however, they lack adequate knowledge of the methods and strategies they might employ to achieve this objective. Teachers expressed the need for specific examples on this issue. The current state of education policy and educational systems is seen to require greater efficiency in order to foster creativity (Kupers et al., 2018). For this reason, teachers need to find ways to develop creativity in their classrooms so that their students can produce creative solutions to the problems they encounter in a modern and globalized world (Aldous, 2007; Henriksen, 2018). Within this framework, in this study it is aimed to examine education faculty students (enrolled in science teaching program) perspectives of creative science teachers and creative science learning environments that will improve students' creative thinking skills and creativity through written and visual metaphors.

Creative Teacher and Creative Learning Environment

Thoughts about the concept of creativity date back to the time of Plato, and has attracted the attention of people throughout history (Maba, 2019; Yeşilyurt, 2020). There are many different definitions of creativity in the literature (Kanlı, 2014), according to Torrance (1988), the reason why the concept does not have a single definition is that it is largely unseen, nonverbal, and unconscious. Also, the belief that creativity is a feature that only gifted people can have has caused the development of this concept to take many years (Yeşilyurt, 2020). But today it is accepted that creativity can be improved through education (Ritter, Gu, Crijns, & Biekens, 2020). Boden (2001, p. 95) define creativity as one's "ability to come up with new ideas that are surprising yet intelligible, and also valuable in some way". Although creativity and creative thinking were initially associated only with art, in later years they also came to the fore in fields such as economy, technology and education (Koray, 2005).

According to Sternberg, Grigorenko and Singer (2004), despite individual differences, the experiences and opportunities individuals have throughout their lives affect the development of creativity. Learning environments in the educational process appear as an important factor in supporting creativity (Kaufman & Baghetto, 2014). A creativitiy supported environment allow individuals to engage and enjoy a learning activity. In such an environment, students will likely be able to develop their skills by exerting greater effort (Richardson & Mishra, 2018) and have the opportunity to practice their skills (Lerang et al., 2019).

Adapting creativity to the classroom environment is a multifaceted and complex process (Jeffrey & Craft, 2004) due to students' different interests, beliefs, abilities, and prior knowledge. For this reason, it is essential to create learning environments that consider individual differences (Kılıç, Yavuz Konokman & Yanpar Yelken, 2018). Therefore, learning environments that are student-centered and employ diverse ways of thinking (Kılıç, Yavuz Konokman &Yanpar Yelken, 2018), consider individuals' developmental characteristics, take cognizance of their decisions, direct them (Yenilmez &Yolcu, 2007), and provide various options (Fleith, 2000) are effective in improving the creativity of individuals. In addition, environments rich in engaging stimuli contain different objects, advanced technology, libraries, and various data and data sources that keep the curiosity of individuals alive (Peterson, 2002).

Teachers need to have several qualities in order to help their students become more creative. Creative teachers have developed imaginations, are prone to problem solving, and are willing to create different learning environments that meet students' expectations by bringing different ideas to the classroom environment. Creative teachers, who see each student as a unique individual, support students to express their thoughts freely and serve as good role models for them (Chambers, 1973; Onur & Zorlu, 2018; Schreglmann & Kazancı, 2016). According to Schreglmann and Kazancı (2016), a creative teacher should be able to provide solutions to problems, organize educational environments according to students' expectations, and provide a

stimulating and engaging learning environment for students. Piirto (2021) discussed the duties of teachers in creating a creative learning environment. These are summarized below:

It is important for teachers to know the characteristics of her students especially their strengths. This will led teacher to plan her lessons taking into account individual differences and help their students to recognize self-awareness. It's also critical to encourage students to take risks, to learn from their mistakes and to showcase their creativity. The way to do this is to create an environment of trust in the classroom. So, students feel at ease asking questions of one another. Teachers should be proficient in methods like mindfulness, meditation, slowing down, and paying attention. Also, teachers should enriched learning environments athletics, foreign languages, dance, theater, music, and art are essentials. Another thing, self-knowledge resources like nature walks, labyrinth walks, meditations, and mandalas can inspire and provide students with insight. Furthermore, education outside the school like field trips to museums also supports creative thinking.

Hadzigeorgiou, Fokialis and Kabouropoulou (2012) determined the features of creative science activities and suggested several activities for creative science:

- Primerly understanding the subject matter of science is necessary for thinking, and thus for creative thinking.
- Divergent and innovative thinking are key components of creativity in science education.
- Promoting the creation of ideas in a safe and criticism-free setting is important
- Curriculum and teaching in science should place a strong emphasis on imagery and visualization.

Taking these features into consideration, creative problem solving, problem solving in science, technology and society context, creative writing, creative science inquiry, creating analogies to understand phenomena and ideas, challenging students to find connections among apparently unrelated facts and ideas, approaching the teaching and learning of science through the arts can be suggested.

This study aims to examine students' perspectives of creative science teachers and creative science learning environments that will improve students' creative thinking skills and creativity through written and visual metaphors.

METHOD/MATERIALS

Since this study aims to explore how the participants describe events and phenomena with an inductive approach and to understand their perspectives (Yücel Cengiz & Ekici, 2020), the study was designed in accordance with the qualitative research approach.

Participants

Participants consist of 1st, 2nd, 3rd, and 4th-grade education faculty students* who voluntarily participated in the study during the spring semester of 2021-2022 at three state universities in Black Sea Region of Turkey (*students are enrolled in the science teaching program and expressed as "student" in the following sections of the study). In this context, a total of 247 students participated in the study. The distributions regarding the universities and grade levels of the students are given in Table 1.

Table 1. The Universities and Grade Levels of the Students

Variable		Frequency (f)
University	Grade Level	
A University	1st grade	20
	2nd grade	28
	3rd grade	18
	4th grade	31
B University	1st grade	35
	2nd grade	28
	3rd grade	17
	4th grade	10
C University	1st grade	27
	2nd grade	21
	3rd grade	6

	4th grade	6
Total		247

Table 1 shows that 82 students participating in the study are in the 1st grade, 77 in the 2nd grade, 41 in the 3rd grade and 47 in the 4th grade.

Data Collection Tool

The study's data consists of metaphors and drawings created by students. Metaphors are tools that reveal how individuals interpret events, situations, and thoughts (Cerit, 2008). Drawings, like metaphors, allow individuals to reflect on their feelings and thoughts (Barrantes Elizondo, 2019) and convey their ideas in situations where they cannot be expressed via words. (Cengiz & Ekici, 2019). For these reasons, these two sources were used together as a data collection tool in this study.

Researchers developed a form titled "Creative Learning Metaphor" in order to determine the metaphors of students hold about the concepts of "creative science teacher" and "creative science learning environment." Examining the current research in the literature served as the basis for the development of the form, which was then refined with the advice of two researchers who are experts in the field of science education. In the first section of the form, respondents were asked to complete the following sentences based on their ideas: "Creative science teacher is similar to..... because....." and "Creative science learning environment is similar to..... because.....". Before using form as data collection tool, it was first conducted to eight students from all grade levels, thus trying to determine the understandability of the form. It was determined that students completed the form within 15-20 minutes without any problems.

Analysis of Data

Before beginning the data analysis, the forms filled out by students were numbered from 1 through 247. Then, the data gathered from the forms was contextually analysed (Lichtman, 2010). The phases of the analysis procedure are detailed below (Ekici, 2016a; Saban, 2008).

1. Metaphors developed by students were listed, and a list was created for this purpose.
2. The distribution categories for the metaphors provided by students were identified. The "because..." section, in which students explain the rationale behind the metaphors they created, was considered for identifying these categories.
3. The listed metaphors were distributed into appropriate categories.
4. During the analysis of the students' drawings, each object, situation, and shape was identified. Each object was counted and the frequency of its inclusion in the drawings was given.

Ensuring Validity and Reliability

The following procedures were carried out to ensure the validity and reliability of the study (Hruschka et al., 2004; Miles & Huberman, 1994; Ratcliff, 1995; Yıldırım & Şimşek, 2016).

• Data analysis and data collection process are explained in detail in the process of listing the metaphors, creating the appropriate categories, and distributing the metaphors to these categories.

• Examples of metaphors and explanations created by students are given in the findings section of the study.

• Attempts were made to determine the similarities and differences between this study and previous research on this issue.

In order to ensure the reliability of the study, the compatibility between the coders was examined. 15% of the papers were coded independently by two researchers for the metaphors. The percentage of agreement between the coders was calculated using the formula Reliability=Number of agreements/(number of agreements+number of disagreements)*100 developed by Miles and Huberman (1994). Coherence between coders was calculated as 92% for metaphors. The fact that agreement across coders is at least 90% demonstrates that the study's reliability can be reached (Miles & Huberman, 1994). For the drawings, one of the researchers who conducted the study created the categories. Then, the other researcher examined the drawings included in the categories, the differences of opinion were discussed among the researchers, and a consensus was reached.

FINDINGS

The findings obtained from the study were examined under two headings: the metaphors developed for the creative science learning environment and their distribution according to categories, and the drawing examples related to the creative science learning environment and their distribution according to categories.

Creative Teacher and Creative Learning Environment

Students' metaphors and explanations for the creative science learning environment were evaluated together. This way, a total of 98 metaphors created by students were gathered under seven categories. These categories were "versatile, limitless,

observable, exploratory, entertaining, intertwined with nature, and need-based". Next, relevant categories and metaphors were gathered under these categories, and their frequencies were tabulated. An example of the "entertaining" category is given in Table 2.

Table 2. Metaphors of the Entertaining Category

Category	Class	Metaphors	f
Entertaining	1	Game room (2), circus show (1), leisure (1), playground (1), funfair (1), entertainment area (1)	7
	2	Amusement park (3), play dough (1), house (1), playground (1)	6
	3	Amusement park (5), picnic area (1), ball pool (1), carnival (1), drama hall (1), playground (1)	10
	4	Amusement park (2), stage (1), wonderland (1)	4

The metaphors created by the students for the creative science learning environment, such as the amusement park, game room, playground, picnic area, carnival, and drama hall were gathered under the fun category. The statements of the students show that they think creativity can develop in an entertaining environment. For example, S193 described the creative science learning environment with the “circus show” metaphor and explained, "I think a creative science learning environment is similar to a circus show. Because similar to a circus show, experiments bring creativity to the forefront in a wide variety of areas."

Versatile

The metaphors created by the students for the creative science learning environment, such as the puzzle, factory, ecosystem, discovery island, botanical garden, earth, sky, nature, universe, multi-program machine, library, rainbow, and forest metaphors were categorized as versatile. In their explanations, the students who stated these metaphors asserted that the creative science learning environment has distinctive features. For example, S236 described the creative science learning environment with the metaphor of "sun" by stating, "I think creative science learning environment is similar to the sun. Because it has a feature that excels in all subject areas and enlightens students by revealing novel concepts."

Limitless

The students’ metaphors for the creative science learning environment, such as the universe, sun, space, laboratory, nature, sky, earth, and ocean, were grouped under the category of the creative science learning environment without limits. Students consider a creative learning environment to be one that encourages learner autonomy and empowers students to use their creativity. For this reason, these metaphors are grouped under the category of limitless. For example, S109 described the creative science learning environment with the metaphor of "space" and said, "I think creative science learning environment is similar to space. Because space is limitless and open to everything, there should be an endless supply of information and a limitless world of ideas."

Observable

Under the category of observability of the creative science learning environment, students’ metaphors such as laboratory, theater, abstract object, real life, scales, factory, science center, light, zoo, nature, world, sky, science-related goods, movie theater, and stage were compiled. In this regard, students explained that abstract knowledge should be made concrete in a creative science learning environment. For this reason, similar metaphors were grouped under the observable category. For example, S44 described the creative science learning environment with the metaphor of "nature" and said, "I think creative science learning environment is similar to nature. Because we observe everything in nature better, they are the regions accessible for observation and examination at any time. Science is life itself."

Exploratory

The metaphors created by the students for the creative science learning environment such as laboratory, experimental setting, fair, campground, playground, world, the place where we can feel great emotions from small things, school, the room where secret potions are made, space, puzzle, museum, science center, experiment table, inventing, factory, place of scientific research, shooting star from the sky, an island full of impossibilities, garden, planet, forest, all environments, play dough and nature were gathered under the category of the exploratory science learning environment. Students believed that the creative science learning environment would allow them to develop a new product or concept as a result of the activities and experiments to be conducted. For this reason, these and similar metaphors are grouped under the exploratory category. In this regard, S58 described the creative science learning environment with the metaphor of "factory" and said, "I think the creative science learning environment is similar to a factory. Because, just as machines work to make a product in a factory, students work in a science learning environment to develop and discover something."

Nature

The metaphors of the students for the creative science learning environment such as nature, garden of the house, forest, world, laboratory, events in nature were gathered under the category of creative science learning environment intertwined with nature. Especially those students who stated that nature is the basis of science and creativity and that the events taking place in

nature can be explained by combining science and creativity together, frequently produced metaphors such as nature and forest. These and similar metaphors were grouped under the category of intertwined with nature. On this basis, S134 described the creative science learning environment with the metaphor of "events in nature" and stated, "I think a creative science learning environment is similar to the events that take place in nature. Because there are numerous scientific events in nature. Science simply explains how it rains, how birds fly, and how plants make their own food".

Needs-based

The students' metaphors for the creative science learning environment, such as the library, technology, nature, the building's foundation, the environment with science-related goods, the cloud, the computer, and the stationery environment, were categorized under the needs-based creative science learning environment. In general, students characterized the creative science learning environment as one that provides them with all the materials, tools, and instruments necessary to develop their creativity. For this reason, these and similar metaphors were grouped under the category of needs-based. For example, S19 described the creative science learning environment with the metaphor of a "stationery environment" and said, "I think the creative science learning environment is similar to the stationery environment. Because the students should have access to the materials they need at that time and be able to learn with the materials they choose."

Figure 1 presents the word cloud containing the metaphors created by the students for the creative science learning environment.

Figure 1. Metaphors Related to the Creative Science Learning Environment

Examining Figure 1 reveals that students create the most "laboratory" metaphor for the creative science learning environment. Then came the metaphors such as an amusement park, a forest, space, nature, etc. The three categories containing the most metaphors are provided in Table 3 based on the number of metaphors collected for each category.

Table 3. Categories Containing the most Metaphors by Grade Levels

Grade Level	G1	*f	G2	f	G3	f	G4	f
Category	Exploratory	16	Exploratory	20	Versatile	15	Versatile	16
	Versatile	15	Observable	13	Entertaining	10	Limitless	6
	Observable	13	Versatile	12	Limitless	4	Exploratory	5

*number of metaphors collected under the relevant category

As shown in Table 3, most of the metaphors created by first and second-graders fell into exploratory, versatile, and observable categories. The first and second graders described the creative learning environment as more like an "exploratory" environment. On the other hand, it has been observed that third- and fourth-grade students often describe the creative science learning environment as "versatile". Unlike the first and second graders, students in the third grade produced metaphors that could be grouped under "entertaining" and "limitless" categories. In contrast to students in the first and second grades, individuals in the fourth grade also developed metaphors that could be classified as "limitless". Finally, unlike the third and fourth grades, the creative learning environment is described as "observable" in the first and second grades.

In Figure 2, the objects utilized by students in their drawings of a creative science learning environment are presented as a word cloud.

Figure 2. Objects Related to the Creative Science Learning Environment

When Figure 2 is examined, it has been determined that the most frequently used object in the drawings of the students regarding the creative science learning environment is laboratory materials. The laboratory materials are followed by drawings for the seating arrangement, nature/forest, and experimentation.

Table 4. Objects Included in the Drawings Related to the Creative Science Learning Environment

Grade Level	Drawing	f	Drawing	*f
1st Grade	Laboratory materials	34	Technological tools	4
	Nature/forest	20	3D material	2
	Experimentation	16	Beach	1
	Seating arrangement	5	Space	1
			Botanic garden	1
			Universe	1
			Library	1
			Poster	1
2nd Grade	Laboratory materials	30	Poster	4
	Seating arrangement	23	Theatre	2
	Technological tools	14	Space	2
	Experimentation	11	Fun fair	2
	3D material	11	Research office	1
	Nature/forest	9	Zoo	1
	Library	8	Park	1
			City	1
			Team work	1
			Virtual reality	1

	3rd Grade	Seating arrangement	13	Technological tools	4
		Laboratory materials	12	Nature/forest	4
		Library	5	3D material	4
				Playground	2
				Experimentation	2
				Schoolyard	1
				Poster	1
				Space	1
				Team work	1
				Fun fair	1
	4th Grade	Nature/forest	14	Theatre scene	4
		Experimentation	12	Library	3
		Laboratory materials	12	Submarine	1
		Seating arrangement	8	Science Center	1
		Technological tools	7	Ocean	1
		3D material	6	Beach side	1
				Station technique	1

f frequency: 5 and more than 5 *f frequency less than 5

In Table 4, the objects and their frequencies in the drawings of the students regarding the creative science learning environment are given. As seen in the table, the objects that appeared most frequently in the drawings of students in the first and second grades were laboratory materials, whereas these objects ranked second and third in the drawings of third and fourth-grade students. In addition, while the seating arrangement is the most frequently used drawing in the third grade, nature/forest drawings are the most common in the fourth grade.

Creative Teacher: Metaphors

Students' metaphors and explanations for the creative teacher were evaluated together. A total of 122 metaphors created in this direction were gathered under ten categories. These categories were determined as versatile, remarkable, limitless knowledge, individual differences, innovative, guide, elaborative, process management, curious, and exploratory. Relevant categories, metaphors gathered under these categories, and their frequencies are tabulated. An example of the "guide" category is given in Table 5.

Table 5. Metaphors of the Guide Category

Category	Grade	Metaphors	f
Guide	1	Nature (3), sunlight (3), tree (1), sun (1), ship captain (1), candle (1), compass (1), rose (1), library (1), seed (1), tree roots (1), air (1), iron (1), guide (1)	18
	2	Sun (4), compass (2), pole star (1), moon (1), mirror (1), Superman (1), internet (1), light (1), key (1), torch (1), candle (1), guiding light (1), guide (1), imagination (1)	18
	3	Entrepreneur (1), earth (1), light (1), compass (1), play dough (1), pilot (1)	6
	4	Leader (1), computer (1), mentor (1), painter (1), chameleon (1), key (1), mother (1), candle (1)	8

Regarding the characteristics of the creative science teacher, the metaphors that students used such as nature, sunlight, tree, sun, ship captain, candle, compass, rose, library, seed, tree roots, air, iron, guide, pole star, moon, mirror, superman, internet, light, key, torch, guiding light, guide, imagination, entrepreneur, earth, play dough, pilot, leader, computer, guide, painter, chameleon, and mother were gathered under the category of the creative science teacher as a guide. The students stated that creative teachers should lead and direct their students and serve as a guide for every learning situation the students may encounter. For this reason, these metaphors are grouped under the category of the guide. S36 described the creative science

teacher with the metaphor of the "pole star" and said, "I think a creative science teacher is similar to a pole star. Because our guide when we are confused about a topic is the teacher".

Versatile

Regarding the characteristics of the creative science teacher, metaphors such as the brain, wrench, tree branches, captain, solar system, rainbow, oxygen, puzzle, matryoshka, tree, scientist, pencil, space, ocean, colored beads, colors, factory, sun, and computer were collected under the category of the creative science teacher as a versatile person. In their explanations, students asserted that a creative teacher must possess various skills and knowledge of numerous subjects. For this reason, these and similar metaphors are grouped under the category of versatile. For example, S35 described the creative science teacher with the metaphor of "ocean" and said, "I think a creative science teacher is similar to the ocean. Because it is creative, it is as vast as the ocean and diverse in many ways".

Remarkable

Regarding the characteristics of the creative science teacher, metaphors such as the clown, buffoon, scientist, physics teacher, intelligence cube, painter, cartoon, magic, surprise box, magician, theater artist, magic box, star, fun day, Disney character, entertainer, rainbow were collected under the category of the creative science teacher as a remarkable person. These and similar metaphors were classified under the remarkable category since students claimed in their explanations that a creative teacher should grab attention in every context, provide variety in the learning environment, and leave students wondering. In that respect, S74 described the creative science teacher with the metaphor of a "star" and said, "I think a creative science teacher is similar to a star. Because a creative teacher grabs the student's attention and keeps them focused".

Limitless knowledge

Regarding the characteristics of the creative science teacher, metaphors such as the book, pen, light, intellectual, philosopher, software developer, treasure, scientist, space, sun, Rick, the lead role in the series, internet, naturalist, astronaut, forest protector, library, inventor, teacher, the computer, universe, science literate and sky were collected under the category of the creative science teacher as a person having limitless knowledge. Since the students stated in their explanations that the creative teacher should be able to provide sufficient responses to all students' questions and that the teacher should have the answer to each question they sought, these and similar metaphors were categorized as limitless knowledge. In this vein, S82 described the creative science teacher with the metaphor of "intellectual" and said, "I think a creative science teacher is similar to an intellectual. Because his knowledge encompasses all branches of science, he can enlighten people on any issue".

Individual Differences

Regarding the characteristics of the creative science teacher, metaphors such as knowledge, rainbow, earth, clown, tree, and scientist were collected under the category of the creative science teacher as a person paying attention to individual differences. These and similar metaphors were grouped under the category of individual differences because students stated that a creative teacher should consider the characteristics of all students and, if the student's characteristics differ, they should plan the entire instructional process accordingly. In this context, S108 described the creative science teacher with the metaphor of a "rainbow" and said, "I think a creative science teacher is similar to a rainbow. Because each student's learning style is unique, their approach to learning will be different. So, each color of the rainbow represents a distinct strategy".

Innovator

Regarding the characteristics of the creative science teacher, metaphors of the magician, researcher, original individual, idol, dreamer, scientist, space, book, pencil, comedian, cube, miracle, tree, engineer, imagination, computer, scholar, matryoshka, factory, speed of light, nature, painter, newsletter, ant, seed, and theater actor were collected under the category of the creative science teacher as an innovator. The students stated that creative teachers should be able to come up with new ideas and products and encourage their students to do so. For this reason, these and similar metaphors are grouped under the innovator category. S83 described the creative science teacher with the metaphor of "researcher" and said, "I think a creative science teacher is similar to a researcher. Because he/she constantly seeks to add new knowledge to his/her existing store and he/she is innovative".

Elaborative

Regarding the characteristics of the creative science teacher, metaphors of the filter, scientist, microphone, photographer, painter, and the one who prepares an experimental environment for the students with the materials they have in every condition, were collected under the category of the creative science teacher as an elaborative person. The students stated that the creative teacher should give importance to details and that it is necessary to pay attention to the details to reveal creativity. For this reason, these and similar metaphors are grouped under the category of elaborative. As an illustration, S5 described the creative science teacher with the metaphor of a "painter" and said, "I think a creative science teacher is similar to a painter. Because, similarly to how a painter focuses on the nuances of natural elements in each painting, a science teacher addresses each material and event in nature in each lesson".

Process management

Regarding the characteristics of the creative science teacher, metaphors of heart, time, ocean, world, comedian, scientist, superhero, and freedom were collected under the creative science teacher's process management category. These and similar metaphors were classified under the category of process management, as students claimed that a creative teacher should manage time effectively and be able to control the entire process when planning the lesson. As for example, S6 described the creative science teacher with the metaphor of a "comedian" and said, "I think a creative science teacher is similar to a comedian. Because he uses the time given to him most effectively and efficiently".

Curious

Regarding the characteristics of the creative science teacher, metaphors of scientist, hero, clown, and surprise gift were collected under the category of the creative science teacher as a curious person. Since students emphasized that curiosity is a prerequisite for creativity, they asserted that a creative teacher also needs to be curious. For this reason, these and similar metaphors are grouped under the curious category. S192 described the creative science teacher with the metaphor of "scientist" and said, "I think a creative science teacher is similar to a scientist. Because, observantly and inquisitively, s/he conducts investigations that have never been done before".

Explorer

Regarding the characteristics of the creative science teacher, metaphors of scientist, young child, researcher, inventor, computer, magician, ant, worker bee, wanderer, and laboratory, were gathered under the category of the creative science teacher as an explorer. These and similar metaphors were grouped under the explorer category, as students stated that the creative teacher should give importance to discovery and that they should allow their students to explore in this context. S238 described the creative science teacher with the metaphor of a "traveler" and said, "I think a creative science teacher is similar to a traveler. Because creativity enables people to find and acquire new information continuously. A teacher with a creative way of thinking learns through exploring like a traveler."

The metaphors students have developed for the creative science teacher are presented in Figure 3 as a word cloud.

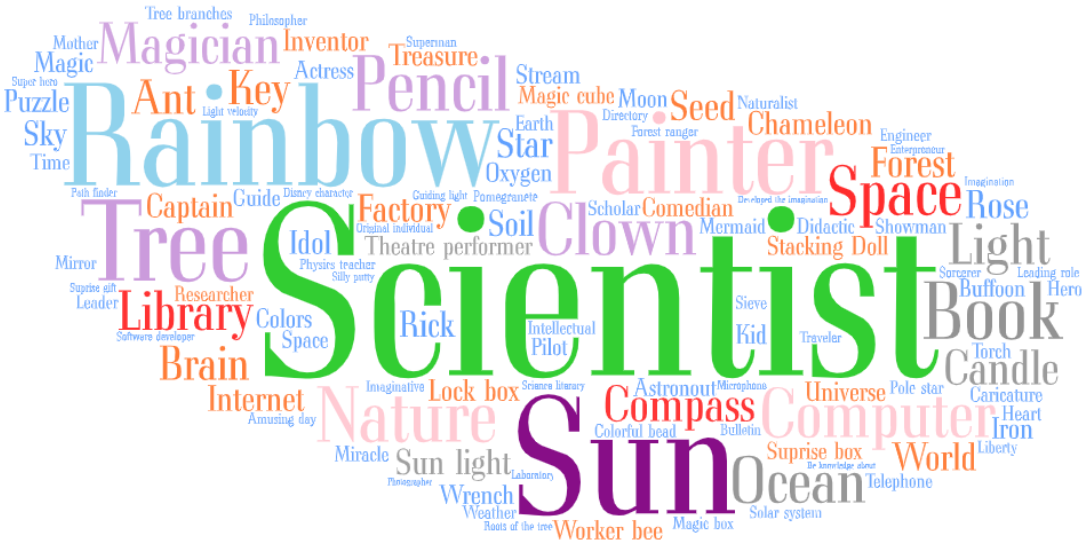

Figure 3. Characteristics of the Creative Science Teacher

Figure 3 shows that "scientist" was the metaphor students created the most for the creative science teacher. The rainbow, sun, and nature metaphors followed this.

As a result of combining the metaphors under each category, the three categories with the most metaphors are presented in Table 6.

Table 6. Categories Containing the most Metaphors by grade Levels

Grade Level	G1	*f	G2	f	G3	f	G4	f
Category	Guide	18	Guide	18	Versatile	10	Remarkable	10
	Versatile	14	Limitless knowledge	12	Limitless knowledge	7	Innovative	10
	Limitless knowledge	14	Innovative	11	Guide	6	Guide	8

*the number of metaphors collected under the relevant category

As can be seen in Table 6, the metaphors produced by the first and second-grade students were gathered in the categories of guide, versatile, innovative, and limitless knowledge. The creative teacher was described as more of a guide by students in the first and second grades; on the other hand, it is seen that third-grade students generally describe the creative teacher as versatile. In the fourth grade, students characterized the creative teacher as remarkable and innovative. According to an analysis of all grade levels, the guide category is one of the three most frequently repeated categories across all grade levels.

DISCUSSION

The findings obtained from the study revealed that students use a variety of metaphors to describe the creative learning environment. When the metaphors are grouped, it is seen that the learning environment is generally described as an environment that is versatile and suitable for exploration. When the literature is examined, evidence regarding the necessity of a versatile learning environment is located. Fleith (2000) states that environments that support creative thinking should offer students different options and encourage them to look at things from different perspectives (Fleith, 2000). Moreover, this result is supported by the fact that creative thinking does not have a single dimension; instead, it has multiple characteristics, including fluency, flexibility, originality, and enrichment (Köksal Akyol & Salı, 2016). Some studies investigate the metaphorical perceptions of preschool pre-service teachers about the concept of creativity in the relevant literature. One of these studies determined that pre-service teachers mostly associate creativity with nature (Pekdoğan & Kanak, 2015). In another study, students described the concept of creativity as producing unique and original products (Tok, 2015). In another study, in which the metaphors produced by the pre-service teachers studying in the classroom teaching program for the concept of creativity were examined, it was seen that the they associated the concept of creativity with being different (Çağlıyan, 2020). Based on these, it can be said that the findings of the literature on the versatility of the creative learning environment, in the opinion of pre-service teachers, are similar to the findings of this study.

When the categories developed by grouping the metaphors produced by the students were examined, it was determined that the students in the third and fourth grades emphasized the limitless aspects of creativity more frequently than those in the first and second grades. As Boden (2001) stressed understanding the subject matter of science is necessary for thinking creatively. So, this data can be interpreted as upper classes being aware of the importance of subject knowledge in the creative process. Creative learning environments should have features that focus on students' skills and interests (Fleith, 2000). Third graders stressed the entertaining side of creativity more often than students in other class levels. At the same time, students in the first and second grades conceptualize creativity as the ability to produce a unique product. However, as grade levels progressed, it was seen that circumstances conducive to developing creative thinking were stressed more through the use of metaphors. Different point of views can be argued that the perspectives of students towards creativity may have been shaped by the knowledge and experiences they gained in upper grades, such as "science teaching laboratory practices, teaching practicum and out-of-school learning environments in science teaching". So, upper classes are more aware of the aspects of creative science classrooms.

When the drawings made by the students for the creative science learning environment were examined, it was seen that they mostly included laboratory materials in their drawings. This may be due to the fact that the metaphors they developed for creative learning environments are also associated with the laboratory. Thus, pre-service instructors frequently stressed the exploratory nature of the creative learning environment. The laboratory for science lessons is effective in the development of creativity. Studies have shown that creative thinking skills develop when students have access to the laboratory at any time and can conduct various experiments (Hofstein, Shore & Kipnis, 2004). Moreover, activities carried out in nature contribute to individuals' creative thinking. To behave as scientists, individuals must comprehend nature and natural events (Gürbey, Mertoğlu, Sayan & Macaroğlu Akgül, 2022). Therefore, laboratories are essential for promoting positive attitudes toward science education, and they must be adequately equipped for efficient use (Bağ & Küçük, 2017; Çepni & Ayvacı, 2011; Ural & Başaran Uğur, 2018). When the students' drawings were examined, it was observed that they depicted laboratory materials not only in a laboratory setting but also in a classroom or nature. In this regard, it can be said that students do not limit the creative science learning environment to the laboratory; instead, they characterize any space with sufficient infrastructure as a creative science learning environment. Teachers will cultivate their students' creativity when they allow them to propose unique ideas and create flexible learning environments that enable them to find alternative solutions to problems. (Yenilmez &Yolcu, 2007).

To sum up, according to the metaphors and drawings, it can be said that students emphasized the exploratory, versatile, observable, entertaining and limitless aspects of creative science classrooms. Although all these fit with the literature, creative science classrooms are more than “laboratories” and “nature” for observation and exploration. None of the students stressed the importance of scientific inquiry in creative learning environments. The metaphors and drawings were not including the dimensions of scientific inquiry as asking questions, problem solving, designing and conducting investigations, forming hypothesis formation and formulating explanations and reflecting upon explanations and findings (Barrow, 2010).

When the metaphors created by the students for the creative science teacher were examined, it was seen that most of the metaphors were gathered under the "guide" category. Students in the first and second grades generally perceive the creative science teacher as guiding and directing. This finding is similar to the results obtained from previous studies. In the study of Zengin (2018), in which he examined the metaphorical perceptions of school principals towards the concept of a creative teacher, it was found that school principals generally described creative teachers as wise teachers who guide students and apply innovative education models to enrich their learning. Although this category is frequently emphasized by students in the first and second

grades, it has been noticed that metaphors for this category are developed at all grade levels. The teachers' ability to serve as role models and mentors is important for developing their students' creativity (Liuffin, 2014). Therefore, students may have described the creative teacher in this way. Likewise, Aljughaiman and Maurer-Reynalds (2005) underlined that teachers should emphasize the importance of creativity to develop their students' creativity skills, raise their awareness and encourage them to develop their creativity. The points considered important in teacher education were expressed by UNESCO (2002) as having the necessary equipment to develop creativity in students, being a role model, and encouraging creativity. According to the constructivist approach, students must understand what they have learned. For this reason, it was emphasized that the teacher should adopt supportive and facilitating roles (Tezci, Dilekli, Yıldırım, Kervan & Memeti, 2017). It can be said that metaphors such as light, compass, and guide produced by students coincide with the characteristics of creative teachers in the literature (Koç, 2014; Oxford et al., 1998). Students studying in the third grade mostly described the creative science teacher as being versatile. The reason for this can be explained by the fact that the creative teacher has many different characteristics. In the study conducted by Schreglmann and Kazancı (2016), it was discovered that students characterized the creative teacher as one who is continually evolving. In addition, Zengin (2019) examined the metaphorical perceptions of school principals toward the concept of a creative teacher. The study results show that shaping is an important and vital quality for creative teachers.

Another remarkable point is that students describe creative science teachers as having limitless knowledge. It was observed that students in the first and second grades generated more metaphors for this category than those in the third and fourth grades. According to students, a teacher must have limitless knowledge to be creative. For an individual to progress and be creative, he or she must have knowledge of his or her subject; yet, creative individuals think in several dimensions and can view circumstances from different angles (Çağlıyan, 2020).

When the students' metaphors for the creative science teacher were collected, they were categorized as extraordinary, individual differences, innovative, elaborative, process management, curious, and exploratory. San (2008) describes the creative teacher as someone who can invent, experiment, and conduct research. According to Fisher (2004), a creative teacher not only conducts the lesson in light of his knowledge but can also add and diversify different activities to the lesson. Jeffrey and Craft (2006) explain that creative teachers add new dimensions to traditional classrooms and make students more innovative by considering the needs of students and shaping education accordingly. In addition, elaboration is another category in which students' metaphors for the creative science teacher are gathered. Therefore, one of the dimensions of creative thinking is elaboration. Elaboration is defined as the process of enhancing by detailing particular events or concepts in greater depth (Edwards, 2014). Thus, students emphasized creativity's vital elements in creative processes. As mentioned in the relevant literature, it has been seen that there are many classifications for the characteristics of the creative teacher. Therefore, the students' perceptions of the creative science teacher coincide with the creative teacher characteristics in the literature.

CONCLUSION AND RECOMMENDATIONS

The study's findings concluded that most students described the creative science learning environment as a place conducive to discovery, such as the laboratory or nature. In addition, it has been established that there are grade-specific variances in the opinions of students about the creative learning environment. As the grade level progressed, students described environments that encourage creativity as limitless and entertaining, as well as versatile and conducive to discovery. On this basis, the pre-service teacher education effectively provides students with a broader and more diverse perspective on environments that foster creative thinking and creativity.

It was seen that the metaphors developed by the students for the creative teacher were gathered in the "guide" category. Although the number of metaphors produced by the first and second-grade students for this category is higher, it has been concluded that metaphors are produced for this category at all grade levels.

In line with this result obtained from the study, it can be suggested to investigate the factors that cause the change and development in the students' perspectives on creativity according to the grade level.

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Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

Ethics Committee Approval Information

Ethical approval was acquired from Trabzon University Ethics Committee with decision numbered E-81614018-000-2200018897 and dated 13.05.2022.

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APPENDICES

Creative Learning Environment: Metaphors

Versatile

Metaphors developed for the versatile category are listed in the table below.

Table 1. Metaphors of the Versatile Category

Category	Class	Metaphors	f	%
Versatile	1	Puzzle (4), lyrics (1), book pages (1), chain (1), factory (1), tumbler (1), ecosystem (1), tv series (1)	11	6,01
	2	Missing mascara in incomplete eye make-up (1), Canva (1), sky (1), nature (1), universe (1), multi program machine (1), library (1)	7	3,8
	3	Amusement park (2), sun (1), factory (1), laboratory (1), out of school learning (1), room full of stuff (1), puzzle (1), automobile (1), science fair (1), table (1)	11	6,01
	4	Nature (2), amusement park (1), universe (1), car engine (1), festival (1), scene (1)	7	3,8

Limitless

Metaphors developed for the limitless category are listed in the table below.

Table 2. Metaphors of the Limitless Category

Category	Class	Metaphors	f	%
Limitless	1	Universe (2), sun (1), space (1)	4	2,18
	2	Universe (1), laboratory (1), nature (1), space (1), sky (1)	5	2,73
	3	Pencil case (1), space (1), blank (1), Google (1)	4	2,18
	4	Sky (2), world (1), skyline (1), Miky Way galaxy (1), ocean (1)	6	3,27

Observable

Metaphors developed for the observable category are listed in the table below.

Table 3. Metaphors of the Observable Category

Category	Class	Metaphors	f	%
Observable	1	Laboratory (5), theater (1), abstract object (1), real life (1), scales (1), factory (1), science center (1), light (1), zoo (1)	13	7,10
	2	Nature (5), laboratory (2), world (1), life (1), theater (1), science center (1), sky (1), science-related goods (1)	13	7,10
	3	Movie theates (1), real life (1)	2	1,09
	4	Stage (2)	2	1,09

Exploratory

Metaphors developed for the exploratory category are listed in the table below.

Table 4. Metaphors of the Exploratory Category

Category	Class	Metaphors	f	%
	1	Laboratory (8), experimental setting (1), fair (1), campground (1), playground (1), world (1), the place where we can feel great emotions from small things (1), school (1), the room where secret potions are made (1)	16	8,74

Exploratory	2	Laboratory (5), space (4), puzzle (1), campground (1), museum (1), science center (1), experimental table (1), inventing (1), factory (1), place of scientific research (1), shooting star from the sky (1), an island full of impossibilities (1), garden (1)	20	10,92
	3	Laboratory (1), planet (1), forest (1)	3	1,63
	4	All environments (1), laboratory (1), factory (1), play dough (1), nature (1)	5	2,73

Nature

Metaphors developed for the nature category are listed in the table below.

Table 5. Metaphors of the Nature Category

Category	Class	Metaphors	f	%
Nature	1	Nature (7), garden of the house (1), forest (1), world (1), laboratory (1)	11	6,01
	2	Forest (3), nature (2), events in nature (1)	6	3,27
	3	-	-	-
	4	Nature (2)	2	1,09

Needs-based

Metaphors developed for the needs-based category are listed in the table below.

Table 6. Metaphors of the Needs-Based Category

Category	Class	Metaphors	f	%
Needs-based	1	Library (1), technology (1), nature (1), building's foundation (1), the environment with science-related goods (1)	5	2,73
	2	Cloud (1)	1	0,54
	3	-	-	-
	4	Computer (1), stationery environment (1)	2	1,09

Creative Teacher: Metaphors

Versatile

Metaphors developed for the versatile category are listed in the table below.

Table 7. Metaphors of the Versatile Category

Category	Class	Metaphors	f	%
Versatile	1	Brain (2), wrench (1), tree branches (1), captain (1), solar system (1), rainbow (1), 0xygen (1), puzzle (1), matryoshka (1), tree (1), scientist (1), pencil (1), space (1)	14	7,65
	2	Ocean (2), colored beads (1), colors (1), factory (1), space (1), sun (1), scientist (1), computer (1)	9	4,91
	3	Forest (2), surprise box (1), world (1), stream (1), rainbow (1), painter (1), telephone (1), pomegranate (1), puzzle (1)	10	5,46
	4	Nature (1), rainbow (1), chameleon (1), lock box (1), actor (1)	5	2,73

Remarkable

Metaphors developed for the remarkable category are listed in the table below.

Table 8. Metaphors of the Remarkable Category

Category	Class	Metaphors	f	%
Remarkable	1	Clown (2), buffoon (1), scientist (1), physics teacher (1), intelligence cube (1), painter (1), cartoon (1), magic (1)	9	4,91
	2	Painter (1), surprise box (1), magician (1), scientist (1), theater artist (1)	5	2,73
	3	Magic box (1), star (1), fun day (1), Disney character (1), entertainer (1)	5	2,73
	4	Rainbow (2), mermaid (1), universe (1), nature (1), lock box (1), magician (1), treasure box (1), clown (1), theater artist (1)	10	5,46

Limitless knowledge

Metaphors developed for the limitless knowledge category are listed in the table below.

Table 9. Metaphors of the Limitless Knowledge Category

Category	Class	Metaphors	f	%
Limitless Knowledge	1	Book (2), pen (2), light (1), intellectual (1), philosopher (1), software developer (1), treasure (1), scientist (1), space (1), sun (1), Rick (1), the lead role in the series (1)	14	7,65
	2	Scientist (4), internet (1), naturalist (1), astronaut (1), forest protector (1), library (1), inventor (1), teacher (1)	11	6,01
	3	Library (2), computer (2), universe (1), science literate (1), space (1)	7	3,82
	4	Sky (1)	1	0,54

Individual Differences

Metaphors developed for the individual differences category are listed in the table below.

Table 10. Metaphors of the Individual Differences Category

Category	Class	Metaphors	f	%
Individual Differences	1	Knowledge (1), rainbow (1)	2	1,09
	2	Soil (1)	1	0,54
	3	Clown (1), tree (1)	2	1,09
	4	Rainbow (4), tree (1), scientist (1)	6	3,27

Innovator

Metaphors developed for the innovator category are listed in the table below.

Table 11. Metaphors of the Innovator Category

Category	Class	Metaphors	f	%
Innovator	1	Magician (2), researcher (1), original individual (1), magician (1), idol (1), dreamer (1), scientist (1), space (1), book (1), pencil (1)	11	6,01
	2	Scientist (3), comedian (1), cube (1), miracle (1), tree (1), engineer (1), imagination (1), computer (1), scholar (1)	11	6,01
	3	Matryoshka (1), pencil (1)	2	1,09
	4	Scientist (2), factory (1), speed of light (1), nature (1), painter (1), newsletter (1), ant (1), seed (1), theater actor (1)	10	5,46

Elaborative

Metaphors developed for the elaborative category are listed in the table below.

Table 12. Metaphors of the Elaborative Category

Category	Class	Metaphors	f	%
Elaborative	1	The one who prepares an experimental environment for the students with the materials they have in every condition (1)	1	0,54
	2	Filter (1), scientist (1), microphone (1), photographer (1)	4	2,18
	3	-	-	-
	4	Painter (1)	1	0,54

Process management

Metaphors developed for the process management category are listed in the table below.

Table 13. Metaphors of the Process Management Category

Category	Class	Metaphors	f	%
Process Management	1	Heart (1), time (1)	2	1,09
	2	-	-	-
	3	Ocean (1)	1	0,54
	4	World (1), comedian (1), scientist (1), superhero (1), freedom (1)	5	2,73

Curious

Metaphors developed for the curious category are listed in the table below.

Table 14. Metaphors of the Curious Category

Category	Class	Metaphors	f	%
Curious	1	Scientist (1), hero (1)	2	1,09
	2	Scientist (1), clown (1)	2	1,09
	3	Suprise gift (1)	1	0,54
	4	Scientist (1)	1	0,54

Explorer

Metaphors developed for the explorer category are listed in the table below.

Table 15. Metaphors of the Explorer Category

Category	Class	Metaphors	f	%
Explorer	1	Scientist (3), young child (1), researcher (1), inventor (1)	6	3,27
	2	Scientist (2), computer (1), magician (1), ant (1), worker bee (1)	6	3,27
	3	Wanderer (1), scientist (1), laboratory (1)	3	1,09
	4	Scientist (1), worker bee (1)	2	1,63