

Full Length Research Paper

An example of the use of personal analogy in teaching Geography: If I were a mineral

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The objective of this study is to use personal analogy as a pre-organizer. The subject of the personal analogy is chosen as minerals. For this purpose, geography teacher candidates were asked the questions, 'Which mineral would you like to be? Why?' They explain the properties of the minerals by matching them with their own characteristics. It is considered that the study will increase their awareness level of the environment. The study was carried out with 67 geography teacher candidates taking the Geomorphology Practice lecture in Karadeniz Technical University, Fatih Education Faculty and Department of Geography Teaching between the academic years 2012-2014. The study is phenomenological. The content analysis was carried out using NVivo 10 software on the data obtained in the research and a model, in which the findings were visualized, was created. As a result of the study, it was found out that most of the geography teacher candidates would like to express themselves by amethyst due to its psychological effect, the attractiveness of its colour and its aesthetic look. Furthermore, minerals were categorized under seven themes according to their aspects of analogy, which are the impression, appearance, the process of formation, content, areas of use, processing conditions and values. It was also found that geography teacher candidates use the concept of the mineral in the place of element and stone. As a result of the study, recommendations were given to promote the application of personal analogies in geography lectures at undergraduate level.

Key words: Mineral, personal analogy, geography teaching, synectics.

INTRODUCTION

Being anxious in the face of a concept, event, fact or situation that is encountered for the first time can be regarded as a response that is in accordance with the human nature. The process of defining, as well as interpreting such a picture can also be complex. It may not be possible to apply all known examples to this new picture, and even if they are applied, it may not be sufficient for its understanding. In this case, as also

stated by Kılıç (2007), a cognitive conflict is experienced in order to make the world understandable. Trying to understand the new situation in terms of the previously known with a mental leap looks like a good solution. There are modern techniques that can be beneficial in reflecting this explanation to education and training areas. *Analogy* and *Synectics*, which is based on analogical thinking, are the leading techniques that

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Table 1. The components constituting the conceptual presentation of the analogy.

| Analog | Target |
|-------------|-------------|
| Attribute 1 | Attribute 1 |
| Attribute 2 | Attribute 2 |
| Attribute 3 | Attribute 3 |

ensure learning the unknown with the help of known.

Etymologically, the Synectics technique emerged as a result of the experimental studies carried out by Gordon with regard to psychoanalysis in order to increase creativity (Gordon, 1961). People become more creative as they move away from the psychological effects controlling their behaviours. The emotion-based component of creativity is more important than its intellectual information based component. Logic plays a vital role in the behaviour control. The ability to act free from logic is important in terms of creating innovative products. Synectics that is based on these principles is grounded on two procedures which are associating the unknown with the known and making the known more interesting (Gordon, 1961). The metaphorical and analogical way of thinking is significant for understanding and implementing the synectics technique.

Analogy, which is one of the most important learning tools for teaching (Duit et al., 2001) is built on the analog and target concepts. The components constitute the conceptual presentation of the analogy in Table 1. In analogies, the known is named as the *Source, Tool or Analogue* where the unknown is named as Target or Subject. The cognitive process named as analogical thinking is a flow of information from the analog to the target concept. Thus, it is important to know the structure of the analog used in this process, as well as to understand the semantic relations and similarities between the analog and target concepts (English, 1997, cited Bayazit, 2011). The components constituting the conceptual presentation of the analogy are as Table 1.

An illustrated example of analogy is given below for a better understanding of the structure of analogy (Glynn, 2008). The example is related to the contour lines within the scope of the geography. In this analogy, it was endeavoured to explain the contour lines with a pictorial analogy. By drawing lines on the back of the hand the contour lines were compared to the protrusions on the fist and the attempt to explain the areas where the inclination increases and decreases was made (Ministry of Education MEB, 2011) (Figure 1).

There are many types of analogies which can be used for various purposes. One of them is the pre-organizing feature. Analogies can be used for organizing prior knowledge at the beginning of the lesson. In this research, it was endeavoured to exemplify the use of personal analogy as a pre-organizer. Personal analogies

are based on the thoughts of students by personally putting themselves in the place of a particular concept, principle, person or object and making the analogy in this way during the process of comparison that are planned to be taught or that are known (Thiele, 1991, cited from Şaşmaz et al., 2011; Özgürbüz, 2013). In the personal analogy, the student can be asked to put himself in the place of an object or another living being. The students associate themselves with anything replaced by themselves. The creative power of the students is activated by asking them to fly like a butterfly, become a tree in the forest and the minute hand of a clock. While defining the personal analogy; Seligmann (2007) used the expression *It is imagining by an individual that he/she is the object that is being studied upon* (Ercan, 2010). Therefore, in personal analogies, the *analog* is the individual himself, and the *target* is the concept, situation or phenomenon with which he associates himself.

Seldomly, analogies contain a classification within themselves. In this context, Seligmann (2007) states that the personal analogy levels created may differ. According to Seligmann, the personal analogy levels are listed as follows (Ercan, 2010);

1. Definition of the reality by the individual: Such kinds of personal analogies are quite superficial and comprise the listing of situations or realities only.
2. Definition of the emotions by the individual: This level of analogy is not sufficient for the emergence of valuable insights while it is at a higher level compared to the definition of the reality.
3. Personal analogy towards living beings: Analogies at this level are defined as *Correct* personal analogies.
4. Personal analogy towards objects: This is the highest level of personal analogy. It includes the attribution of human emotions to inanimate objects.

In the analogy based on starting from the known truth, the students were chosen themselves as the object that can be known best, in other words, as the analog. Furthermore, it is necessary that they know the minerals chosen as the subject or target well. The semantic relationship that is expected to be established between the analog and the target actually refers to the relationship established between oneself and the nature, in other words, how much one internalizes the nature. In this context, our environment is quite a rich source for us. As the individual gets to know it closer and understands it, the source pool that will facilitate materialization will be enriched. As a requirement of the *analogies* that are defined as the expression of the similarity between two concrete or abstract objects (Dagher, 1994: cited Bayazit, 2011; Haglund, 2012; Niebert et al., 2012); it is quite a possible as well as enjoyable reflection of trying to explain human, who has complex powers that are hard to define by comparing him/her to certain pieces of the world (for example, minerals, rocks, trees, clouds, landforms...) that are regarded as his/her small forms.

Example 2: ANALOGY

| <u>Analogue</u> | <u>Target</u> |
|-------------------------|----------------|
| Protrusions on the Fist | Landforms |
| Top View of the Hand | Bird's Eye Map |
| Lines | Contour Lines |
| Our Fist | Relief Map |

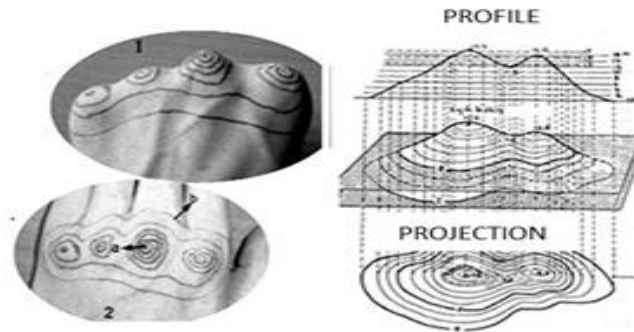


Figure 1. Examples embodying the relationship between analog and target.

When the literature on analogies is examined (Ören et al., 2011), it is seen that experts use their analogical thinking skills in the process of building a bridge between the source and the target in order to expand the analogy example and also overcome conceptual difficulties (Clement, 1987). Similarly, Kılıç (2007) also states in his study that some teachers use analogies to help students perceive and explain the concepts. Nevertheless, according to Dinçer (2005) analogies get students adopt the habit of respecting the opinions and thoughts that are different from theirs as analogies ensure a constant interaction between the students and their friends. Furthermore, Clement (1983) states that in science lessons analogies play an important part in creating a new hypothesis.

Geography lessons internalize the nature. The more the student dominates his surroundings, the easier it would be for him to define and name himself. As is also specified in the general objectives of the Geography Lesson Curriculum, it is essential that students “gain geographical questioning skills and associate basic elements of the universe in the context of human-nature relationship” (Ministry of Education, 2011). In order to accomplish this objective; events happening inside or outside the school should be used in order to emphasise the place of geography in life and how it will change the points-of-view of the students. Activities based on active learning should be applied rather than transmitting the phenomena or events or having students memorize the course books. With modern methods and techniques, the students should be encouraged to think and be

questioned using open-ended questions (Ministry of Education, 2011). Today, geography teacher candidates have a significant role to fulfil these purposes in the future. In this context, it is also important to examine the adequacy of geography teacher candidates in the use of analogy.

The questions, the answers to which are sought in this research in which the employability of personal analogy at an undergraduate level in geography major is questioned, are as follows:

1. What are the semantic relationships between the analog and target concept in personal analogies created by geography teacher candidates on the subject of minerals?
2. How can the features used for the analogy be categorized in personal analogies created by geography teacher candidates on the subject of minerals?

METHODOLOGY

Research model

This research uses phenomenology methodology which focuses on the phenomena that we are aware of, but do not have an in-depth and detailed understanding of. Phenomena may appear in various forms, such as events, experiences, perceptions, orientations, concepts and situations, in the world we live in. Phenomenology constitutes an appropriate research basis for the studies aimed to examine phenomena which are not completely alien to us but also the meaning of which we are unable to grasp fully (Yıldırım, Şimşek, 2005). Phenomenology is a qualitative research approach

that focuses on what people perceive.

The data were coded, themes were identified, and after codes and themes had been organized, the findings were explained and interpreted.

Participants

The study was carried out with sixty seven geography teacher sophomores taking the *Geomorphology Practice* course planned as two hours (45 min each) at the Department of Geography Teaching in Fatih Education Faculty of Karadeniz Technical University between the academic years 2012-2014.

Data collection tool and data analysis

For the research, all members of the class were encouraged to participate in the activity. As the first step of the research process, the concept of analogy was introduced during one lesson hour (45') and it was presented with various analogy examples. Personal analogy examples were shared. Then the participants were asked to develop personal analogies on the subject *Minerals*. Candidate teachers were given papers containing an analogy that says *If I came to world as a mineral, I wish to be a because....* which should be filled in and explained by candidate teachers. The candidate teachers were asked to fill in the papers with their preliminary knowledge and given a week's time to research the characteristics/properties of the minerals. Worksheets were submitted the following week. The students were not asked to write their names on the paper to allow them to express themselves comfortably. The collection of minerals was introduced to the candidate teachers over two weeks after (4 lesson h) where they had the opportunity to examine minerals closely.

In the research, the characteristics of the individuals, which are to be expressed, were chosen as the *analog* where the properties of the minerals were chosen as the *Target*. Therefore, it was ensured that individuals start from their own characteristics in order to express the properties of the minerals (physical, function, etc.). Candidate teachers put themselves in the place of an inanimate object (minerals) when structuring the personal analogy. Thus, the analogy that is required to be structured is named as the Personal analogy towards inanimate objects and is of the personal analogy type at the highest level.

The findings were analysed using the content analysis. The NVivo 10 software was used to analyse the data. It is a software that gathers the codes under specific themes by the researcher, comparing many samples of data, quick repeating or reviewing the actions made when required, reaching the results obtained on request, establishing a relation between the codes and the researcher's notes and summarizing the data obtained in the form of a model, matrix, graphic or report (Cassell et al., 2005). In the content analysis, similar data were organized and interpreted under certain concepts and themes. For this purpose, the answers were categorized after being read by the researchers. After completing the process, codes were gathered under themes where their frequencies were calculated and interpreted (Yıldırım, 2005). During the analysis process, descriptive statistics given by the frequency distribution were also used. Furthermore, the view of the relevant candidate teacher was given as an example for a better understanding of the codes and themes in the study.

For the reliability of the research, the expressions in the worksheets were coded independently by two expert researchers in the field and field education and then the results were compared where it was seen that both codes were over 90% compatible with each other. In this way, it is observed that coding was performed without prejudices and misunderstandings with common sense.

FINDINGS

The findings for the first research question are as follows: In the first question of the research, the answer to the question *What are the semantic relationships between the analog and target concept in the personal analogies created by geography teacher candidate on the subject of minerals* was sought. In this context, findings showing the semantic relationships between the analog and target concept are listed in Table 2.

When Table 2 was examined, geography teacher candidates identified themselves with Amethyst, Aquamarine, Quartz, Ruby, Diamond, Coal, Obsidian, Amber, Pearl, Olivine, Hematite, Emerald, Lapis, Boron, Labrador, Agate, Platinum, Pyrite, Limestone, Topaz, Diaspore, Mercury, Opal, Coral, Copper, Tiger's Eye, Turquoise, Talk, Rock Salt, Pebble, Fluorite, Oltu Stone and Amazonite, respectively. They used thirty-three different examples in total to express themselves. The expressions of the teacher candidates related to thirty-three different examples are presented in Table 3.

The findings for the second research question are as follows: In the second question of the research, categories consisting of the properties used with regard to the analogue were questioned. Analogues used by geography teacher candidates in their personal analogies regarding this research question were categorized. For this purpose, the following model was created using NVivo 10. As seen in the model in Figure 2, the analogue properties used with regard to the minerals that constitute the target element were divided into subcategories. Accordingly, geography teacher candidates primarily used the psychological effects the minerals have on them in order to express themselves

Apart from these, they made associations that can be grouped into seven categories, which are the appearance, conditions and duration of formation, content (structure), area of use, function and diversity, the state of processing and preciousness examining these categories in a more detailed way.

Minerals in terms of their effect

Those minerals that come to the fore with their positive psychological effect are amethyst, aquamarine, quartz, ruby, amber, peridot, hematite, emerald, lapis, onyx, platinum, diaspore, tiger's eye, turquoise, fluorite and amazonite. In terms of physiological effect, quartz, aquamarine, ruby, amber, hematite, platinum, fluorite and amazonite were used.

Minerals in terms of their appearance

Another category was created for the minerals used in terms of their appearance. Minerals assessed in this category were mentioned in the analogies as a result of their colour, smoothness, plainness, aestheticism,

Table 2. Analysis of the personal analogies of Geography Teacher candidates regarding minerals.

| No | Target | Relevant candidate teachers | f | Relationship |
|----|--------------|-----------------------------|---|---|
| 1 | Amethyst | 33,38,45,48,58,67 | 6 | Psychological effects, colour, aesthetic appearance |
| 2 | Aquamarine | 27,36,39,40,62 | 5 | Transparency, hardness, colour, physiological effect (asthma), psychological effect (gives abundance, luck, confidence and courage) |
| 3 | Quartz | 13,19,53,63 | 4 | Psychological and physiological effect (energy, radiation prevention), stability, protectiveness, variety of colours |
| 4 | Ruby | 30,49,52,54 | 4 | Precious, rare, meaning of its name (queen of stones) psychological and physiological effect (ensures spiritual development) |
| 5 | Diamond | 18,24,46,66 | 4 | Precious, hardness, aesthetic appearance, brightness, transparency, formation conditions, processing difficulties |
| 6 | Coal | 6,8,12,47 | 4 | Precious, various areas of use, transformability, hardness, colour, no renewability |
| 7 | Obsidian | 1,15,21,65 | 4 | Conditions of formation, property of dissection, hardness, various areas of use, being affected by external conditions, functionality, colour |
| 8 | Amber | 42,51,57 | 3 | Psychological and physiological effect (takes away negative vibes), conditions of formation, period of formation, appearance |
| 9 | Pearl | 41,61 | 2 | Period of formation, conditions of formation, purity, organicity, colour |
| 10 | Olivine | 34,55 | 2 | Aesthetic appearance, variety of colours, psychological effect (gives joy, clears off emotional coldness) |
| 11 | Hematite | 37, 44 | 2 | Psychological and physiological effect (reduces stress) attractiveness |
| 12 | Emerald | 23,64 | 2 | Psychological effect, meaning of the name (the stone of unconditional love) |
| 13 | Lapis Lazuli | 26,50 | 2 | Colour (stone of the skies), psychological effect (balance, thinking deeply, farsightedness), heterogeneous structure |
| 14 | Boron | 9,20 | 2 | Richness of reserve, unrecognized value, strategic, heat resistant |
| 15 | Labrador | 4,2 | 2 | Iridescence, variety of colours, transparency, reflection, rareness, aesthetic appearance, processing difficulties |
| 16 | Agate | 10, 31 | 2 | Variety of colours, psychological effect (prevents stress, prevention against evil eye) |
| 17 | Platinum | 11 | 1 | Resistance, psychological and physiological effect |
| 18 | Pyrite | 25 | 1 | Conductivity, brightness, hardness |
| 19 | Limestone | 14 | 1 | Cemented structure |
| 20 | Topaz | 16 | 1 | Colour, intensity of demand |
| 21 | Diaspore | 17 | 1 | Variety of colours, rareness, psychological effect (takes away bad energy) |
| 22 | Quicksilver | 7 | 1 | Various areas of use |
| 23 | Opal | 22 | 1 | Colour changing |
| 24 | Coral | 5 | 1 | Rough surface, colour |
| 25 | Copper | 3 | 1 | Various areas of use, functionality, intensive demand |
| 26 | Tiger's Eye | 28 | 1 | Hardness, psychological effect, iridescence |
| 27 | Turquoise | 29 | 1 | Psychological effect (brings luck, protects against evil eye, increases wisdom) |
| 28 | Talc | 32 | 1 | Hardness, crystal structure |
| 29 | Rock Salt | 36 | 1 | Simplicity, transparency |
| 30 | Pebble | 43 | 1 | Accessibility, ordinariness, shape, way and process of formation |
| 31 | Fluorite | 56 | 1 | Psychological and physiological effect (increases concentration, takes away fears) |
| 32 | Oltu stone | 59 | 1 | Easily processes, colour, shines as it is used |
| 33 | Amazonite | 60 | 1 | Psychological and physiological effect |

brightness, transparency and reflective properties. Geography teacher candidates used amethyst, aquamarine, coal, obsidian, pearl, oltu stone, coral, lapis lazuli and topaz for their special colours. Quartz, peridot, labradorite and agate were used in terms of their variation of colour. Iridescence is one of the properties that are used for zultanite, opal, tiger's eye and labrador.

The uneven surface of coral, plainness of rock salt, and the aesthetic appearance and source of amethyst, diamond, peridot, labrador and amber were used for the description. The brightness of diamond and pyrite, and shining of oltu stone by use were used in the analogies. The transparency of aquamarine, diamond, labrador and rock salt, and reflection of sun rays by labrador ranked as

Table 3. The examples of the expressions of the teacher candidates.

| No | Target | The teacher candidate's expression |
|----|---------------|---|
| 1 | Amethyst | T45: <i>This stone collects the negative energy in its environment and turns it into positive energy, I think I also spread positive vibes around.</i> |
| 2 | Aquamarine | T39: <i>I am transparent like an aquamarine. I am straightforward. I do not think ill of anybody. And I give a tough first impression. Aquamarine has a hardness of 7.5-8. However, those who know me closely say that I am soft-hearted.</i> |
| 3 | Quartz | T19: <i>When quartz appears white among the colourless and colouring minerals, it becomes "Milky Quartz", and when it appears purple, it becomes Amethyst. My character also gains colour when I meet different characters.</i> |
| 4 | Ruby | T52: <i>As it develops understanding and toleration towards others...</i> T49: <i>People should envy when they look at me.</i> |
| 5 | Diamond | T46: <i>I am a diamond; Not a lot of people can process me and please me.</i> |
| 6 | Coal | T12: <i>I bear the traces of the past, I mature in time, and I am precious at all times.</i> |
| 7 | Obsidian | T21: <i>It is a mineral that has always worked for human beings, just like the profession of teaching. Although their colours differ, their purposes are always the same. It resists difficulties, sometimes falls apart. When it falls apart, it is sharper and more determined than ever before; and for some people, it is sacred.</i> |
| 8 | Amber | T57: <i>It is like holding on to life by keeping the liveliness inside in the face of what amber experiences...</i> |
| 9 | Pearl | T61: <i>My existence began in the shell of an oyster; its resistance is quite high. It is hard to account for the structure of the shell... Its calcium carbonate content is a deterrent against many threats. It isolates the intruders and cover them up with the mother-of-pearl.</i> |
| 10 | Olivine | T55: <i>There are times when I turn in upon myself. Light green reflects the times when I am sociable and talkative, and dark green reflects the times when I turn in upon myself.</i> |
| 11 | Hematite | T44: <i>It would be a nice feeling to be able to give people energy and liveliness...</i> |
| 12 | Emerald | T23: <i>I would have liked to be an emerald and spread to everywhere of the world. Enter any home, reach anyone and distribute unconditional love.</i> |
| 13 | Lapis- Lazuli | T50: <i>I may exist in different tones, but I am blue. I am not pure; I am the combination of different minerals. As a result, you see a beautiful sight.</i> |
| 14 | Boron | T20: <i>Although I am unappreciated today, I would like to provide benefit to my country in strategic areas and serve people.</i> |
| 15 | Labrador | T4: <i>I am colourless and spiritless without those who understand me, i. e. without the sun; but I reflect my seven colours with the sun.</i> |
| 16 | Agate | T10: <i>It is good for mental distresses, just like me.</i> |
| 17 | Platinum | T11: <i>It is resistant against chemicals. It is stable; it does not undergo corrosion against high temperature. I also do not sink into pessimism due to external influences.</i> |
| 18 | Pyrite | T25: <i>I like showing off. What's the harm in people thinking that I am golden although I am not? Maybe I can teach others to be happy with small things with this trickery...</i> |
| 19 | Limestone | T14: <i>Family relations are important to me. I am attentive to establish a strong relationship with each member of the family, just like a strong building. If it lacks cement, it cannot endure shakes. And the cement of this nature is limestone.</i> |
| 20 | Topaz | T29: <i>I bring luck, I believe in the evil eye, I want more wisdom.</i> |
| 21 | Diaspore | T17: <i>Diaspore is used directly after it is extracted from the underground, without processing. However, it is very hard to extract it. It requires really fine manual labour. The person who will reveal my properties should also work very hard.</i> |
| 22 | Quicksilver | T7: <i>I am useful in so many things from the painting of the ships to the glazing of mirrors, and fillings that I do not know what people would do if it was not for me.</i> |
| 23 | Opal | T22: <i>I shape and respond in accordance with the warmth I receive from others. I know I change colour with palm heat. Furthermore, that it gets to the super ego attracted me as I am looking for perfection.</i> |
| 24 | Coral | T5: <i>...It has a rough and stained structure. It is not smooth and perfect. I am also not perfect; I think the humble and careless structure of coral matches me.</i> |
| 25 | Copper | T3: <i>I would have liked to be copper as it is used and needed in many areas of daily life.</i> |
| 26 | Tiger's Eye | T28: <i>I am tough as well as fragile. I hide this characteristic of mine as I cannot easily pull myself together. Also, I have enhanced empathy skills.</i> |
| 27 | Turquoise | T16: <i>...It has been demanded in all periods; I should also not lose my value at any time.</i> |
| 28 | Talc | T32: <i>That it is easily scarred exactly defines how I am now. I can be affected negatively even by the smallest things. Its bright crystal state is the state I want to be in. I want to draw the attention.</i> |
| 29 | Rock Salt | T36: <i>Simplicity comes to the fore in one's thoughts with this mineral. One decides easily. One knows what she/he wants. And this is in parallel with my character.</i> |
| 30 | Pebble | T43: <i>I would not like to wait for the special occasions that happen a few times a year to meet people. I would like to be in a place where they can always find me. I would not like to be one of those that are used only when they are happy. I can be a stone that is thrown into the sea out of boredom. I can be one of those played by children...</i> |
| 31 | Fluorite | T56: <i>...as it increases concentration and eliminates the feeling of insufficiency...</i> |

Table 3. Cont'd.

| | | |
|----|------------|--|
| 32 | Oltu stone | T59: <i>This mineral shines by use. And I get appreciated as I work, and work more when appreciated, and shine like an oltu stone.</i> |
| 33 | Amazonite | T60 : <i>I make people who feel my existence accept changes in their lives easily.</i> |

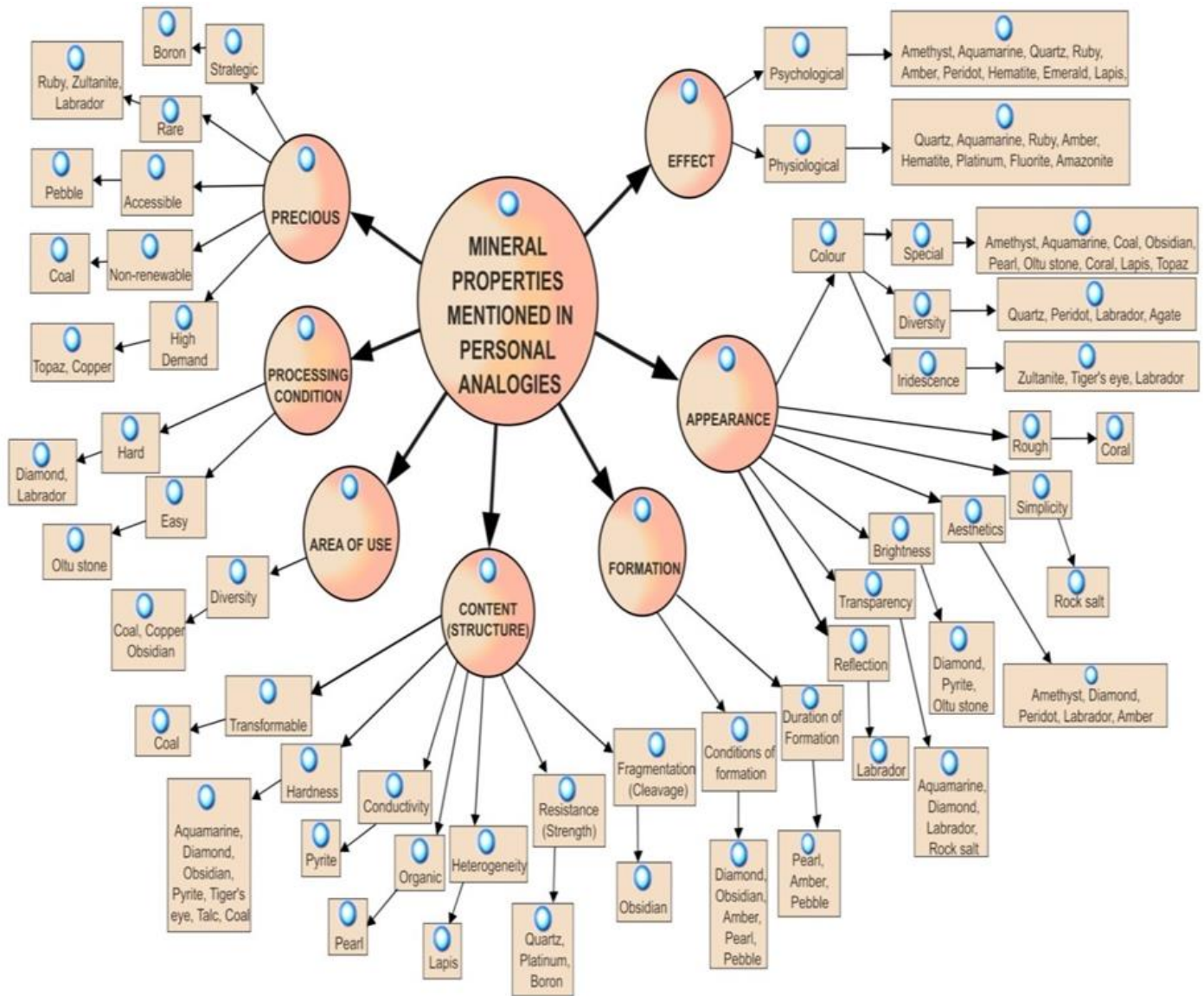


Figure 2. The content analysis model with respect to the categories of the target.

the categories that represented the image in the analog.

Minerals in terms of the formation process

While pearl, amber and pebbles were used in terms of the duration of formation; the formation conditions of diamond, obsidian, amber, pearl and pebble were mentioned in the analogies.

Minerals in terms of content (structure)

While obsidian ranked in the category assessed in terms of the content (structure) with its conchoidal fracture property; quartz and platinum were mentioned in terms of their stability (resistance), and boron in terms of its heat-resistance. The heterogeneous structure of lapis lazuli, organic content of pearl and conductivity of pyrite were among the properties that represented geography

teacher candidates. Aquamarine, diamond, obsidian, pyrite, tiger's eye, talc and coal were used for their hardness, and the transformability of coal into a diamond in time under high pressure and temperature was used. Coal, obsidian, quicksilver and copper were mentioned for their various areas of use.

Minerals in terms of their processing properties

In terms of their processing properties, oltu stone was qualified as easy to process, while diamond and labrador were qualified as hard to process. They constituted an analog relationship with these properties.

Minerals in terms of the value

As the last category, minerals were mentioned in the personal analogies for being precious. Topaz and copper created analogies for being demanded since the ancient times; coal for being one of the non-renewable resources and the risk of its extinction; pebble for being readily available everywhere and for everyone; ruby, diaspore and labrador for being rare; and boron for being strategic.

Other findings obtained in the research process

Two questions take place together in other findings obtained in the research process, which are "Can personal analogies be used in the detection of misconceptions? and *"Which misconceptions were observed in geography teacher candidates while creating personal analogies on minerals?"* Objects with no mineral properties were used in the personal analogies created by teacher candidates on minerals. In the face of this situation, the misconceptions encountered while analysing the analogies of the research were not ignored by creating the heading of other findings obtained in the study process and presented under this heading.

As observed in Table 4, geography teacher candidates tried to express themselves with the help of thirty-three targets. The teacher candidates were asked to use minerals as targets. However, the candidates have misconceptions about the concept of mineral. Minerals were used correctly only in nineteen target expressions among thirty-three expressions in total. In ten of them, stones were used while elements were used in four expressions.

Misconceptions understood from the statements of the geography teacher candidates are as follows: Aquamarine, Ruby, diamond, coal, obsidian, amber, pearl, emerald, lapis, limestone, topaz, diaspore, coral, tiger's eye, turquoise, pebble and oltu stone were regarded as minerals. However, these are all stones. Some of them may be considered as precious stones (diamond, topaz, turquoise, etc.). Coal, pebble, limestone and sedimentary rock stand out, in particular. For, these

Table 4. Scientific definitions of the analogs used by geography teacher candidates in their analogies.

| Target | Scientific definition |
|----------------------|-----------------------|
| Amethyst | Mineral |
| Aquamarine | Mineral |
| Quartz | Mineral |
| Ruby | Stone |
| Diamond | Mineral |
| Coal | Stone |
| Obsidian | Stone |
| Amber | Stone |
| Pearl | Stone |
| Olivine | Mineral |
| Hematite | Mineral |
| Emerald | Mineral |
| Lapis | Stone |
| Boron | Element |
| Labrador | Mineral |
| Agate | Mineral |
| Platinum | Element |
| Pyrite | Mineral |
| Limestone | Stone |
| Topaz | Mineral |
| Zultanite (diaspore) | Mineral |
| Quicksilver | Element |
| Opal | Mineral |
| Coral | Stone |
| Copper | Element |
| Tiger's eye | Mineral |
| Turquoise | Mineral |
| Talc | Mineral |
| Rock Salt | Mineral |
| Pebble | Stone |
| Fluorite | Mineral |
| Oltu stone | Stone |
| Amazonite | Mineral |

are among the stones that can be found in the surroundings where the teacher candidates live, and they can be frequently heard of in daily life. However, these stones were qualified as minerals according to the geography teacher candidates.

Another misconception found out as a result of the research was that minerals and elements were confused. Platinum, quicksilver, copper and boron are elements, not minerals. The same is valid for these elements. These elements were also regarded as minerals by the teacher candidates. An *Element* is a substance that cannot be decomposed by chemical weathering and obtained by synthesis. Elements are pure substances consisting of the same type of atoms and shown with symbols. An element consists of the atoms that are of the same type

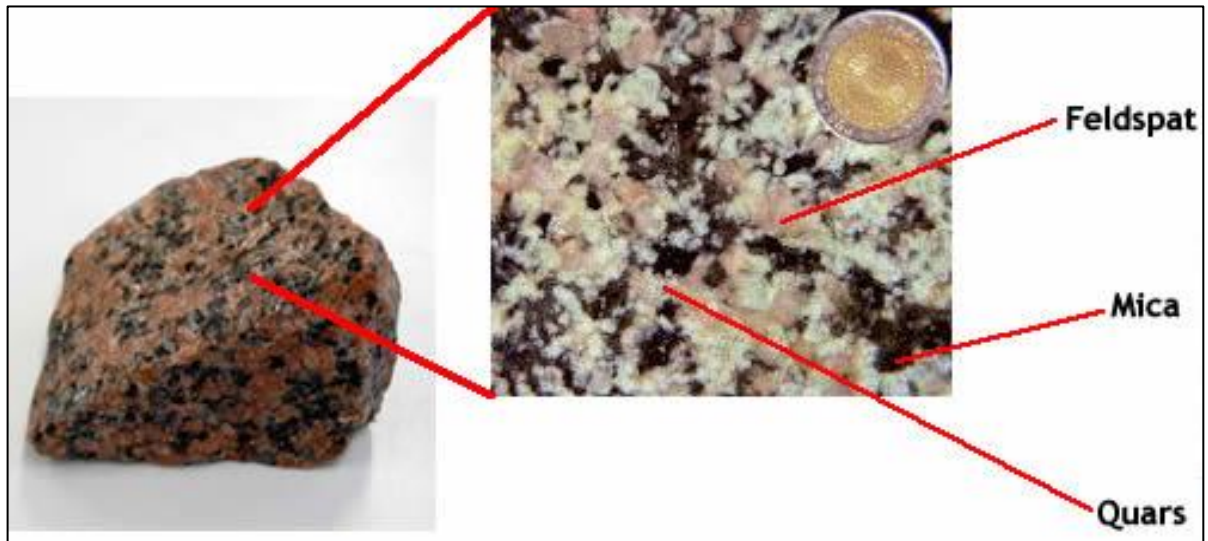


Figure 3. Minerals forming granite.

and not divided in their chemical reactions. They may exist in solid, liquid and gas form. Minerals are homogenous and mostly solid matters that exist in the nature and have a particular chemical composition and a uniform atomic structure. Minerals form rocks by coming side by side (Ketin, 1982).

Rocks are mineral assemblages. They are formed by the coming together of various minerals and stone particles or numerous deposition of a single mineral. Granite and basalt are rocks that are composed of various minerals while sandstone consists of various sand particles (Ketin, 1982). For example, as is shown in Figure 3, Granite is a light coloured rock with an acidic composition, which contains 10-40% of quartz, 30-60% of alkaline feldspar, about 35% of mica and 10-35% of dark coloured minerals (Quartz, feldspar and mica are minerals).

The reason why students confuse the concept of the element with the concepts of mineral and rock is related to not having received an adequate level of chemistry knowledge at the secondary school level. The reason for the confusion of the concepts of mineral and rock may result from the fact that the research was carried out before the course "Geomorphology Practice."

The geography teacher candidates used the concepts of the rock mass and rock with parallel meanings. This is true in accordance with the literature. İzbirak (1969) makes a definition for this issue by using the following expressions: *Matters that are the main substance of the Earth Crust and consist of minerals are gathered under the name stone. The solid and mass state of hard stones is called rock. Rock means a stone that exhibits any height in any place. While the term rock mass is related to rocks.* The same subject was expressed as follows in another study (Sür et al., 2009). *Matters of various colours and properties that are formed of the minerals or*

clastic materials constituting the main substance of the earth crust are called rock mass (stone). In the expression above, stone and rock mass were used synonymously. In Atalay's Natural Sciences Dictionary (2004), it was also used synonymously as follows: *Stone, rock, rock mass: large and hard part of shell in general sense; and hard and relatively soft Lithosphere part that consists of the coming together of mineral parts including mud, clay, sand and coral reef in the geological and geomorphological sense.*

As a result of the research, the geography teacher candidates internalized the nature when building the relationships between the analog and the target. Among the teacher candidates who expressed this situation, T47 used the expression *Each individual is a world. We are actually the miniatures of the world. We are the nature. We are from the nature.*

Another example of the fact that the environmental awareness of the teacher candidates increased is as follows:

For example, T56 explained this by saying *I have not looked at my surroundings this meaningful so far. It is as if each living being whispers me something this year. Even the shapeless stones that we stumble on when walking have a story, they have a message to tell us.* Therefore, it can be said that analogies are effective in increasing the awareness of teacher candidates and their interaction with the nature. It can be said that this also stands out in the creativity of teacher candidates; hence, it is seen that analogies shaped by their imagination are dominant in the expression of concrete objects.

DISCUSSION

The results of the findings obtained from the worksheets

filled in by the geography teacher candidates with their personal analogies including their justifications are as follows;

Minerals formed analog in terms of their structure, content and function. The target element with the most analog use is the mineral amethyst. The effect of amethyst on psychology, its colour and aesthetic appearance manifest themselves as the properties creating analog. In other words, it has been a tool for individuals to express themselves as a result of their function and structure. The geography teacher candidates established a relationship between themselves and psychological effects of minerals. Many minerals were used as analogs in this sense. As is also specified by Kılıç (2011), information on the effects of stones on health is divided into two as objective information the correctness of which is proved and subjective information the correctness of which is not proved; however widely accepted, in parallel to the nature of the relevant subjective and objective science areas. A physical and concrete effect of stones on human health is a subject that is highly open for discussions that create a slippery basis between these two approaches. The tradition of taking shelter in the magical and talismanic power of stones dates back to the earliest times, and philosophers such as Plato and Herodotus have tales on the healing properties of such stones as Lazurite, Malachite, Nephritis and Amber. However, these tales are not just surreal discourses as stones have been used as alternative and objective medical tools in the historical process, and are anecdotes that were shaped in the light of the life experiences and certain rational data of the antique times and enriched with the imagination. Publications such as Sözer (2004) and De Agostini (1998) seem to support these findings. It is believed that the geography teacher candidates obtained this subjective information by being affected by the press, broadcast media, and trendy philosophical movements. On the other hand the teacher candidates also established a link between an inanimate object as an expression of their imagination and creativity in their analogies. In this sense, it can be said that analogies make teacher candidates think creatively in the sense that supports their readiness. Hence, studies carried out in the literature also support this thought (Hoffman et al., 2009, Haglund, 2013; Lancor, 2014). Therefore, it may be recommended to use analogies at different levels and on different subjects for the development of creative thinking skills of teacher candidates.

According to the observations of the researcher, it can be said that the use of personal analogy was effective in order to determine the levels of readiness of the geography teacher candidates on the subject, determine their misconceptions or make an assessment. Furthermore, an environment that will provide an opportunity to get to know the instructor teacher candidates, and the teacher candidate peers closer,

since teacher candidates had the chance to express themselves with the personal analogy, was created. Hence, studies in the literature also support this opinion (Haglund, 2013). In this context, it can be said that the use of analogies may be effective in the development of empathy skills of a teacher candidate. On the other hand carrying out a study based on the comparison of the analogies to be created by geography teacher candidates and teacher candidates in different fields (for example, guidance and counselling) may be recommended.

Another finding obtained as a result of this research is that teacher candidates generally do not prefer the common minerals and generally prefer rare minerals. This result made us question whether the teacher candidates know the region where they live in a geological and geomorphological sense. In other words, their environmental awareness is insufficient. This situation shows that it results from geography teaching that is based on memorization rather than practice, and independent from the environment where one lives. Therefore, it is considered that a working environment must be created combined with such methods and techniques as analogical and metaphorical thinking, synectics for an effective geography education.

When the findings are examined, certain misconceptions stand out. Coal, pebble, limestone, sedimentary rock, platinum, quicksilver and copper that the teacher candidates probably encountered in their preliminary experience or at least known were qualified incorrectly and defined as minerals. The geography teacher candidates confuse the concepts of stone (rock, rock mass) and element with the concept of mineral (Monteiro et al., 2012; Francek, 2013). Furthermore, the need to emphasize the difference between precious stone and stone also stood out in their expressions. Appropriate learning environments to relearn or remember these concepts should be created. For example, research and study tours can be held to nearby surroundings. Geography teacher candidates can be made to collect samples during these tours and create their own collections. Mineral, stone (rock, rock mass) and element types can be presented in the field and laboratories; the differences among them can be shown in practice. In this framework, a project can be started, and an indigenous stone and mineral museum can be created. It is believed that this practice can also be effective in terms of raising awareness towards the environment and internalizing the nature. Therefore, personal analogy, which is one of the synectics methods, can be used in the determination of misconceptions. Appropriate conceptual change approaches can be preferred and used in order to eliminate these misconceptions.

It was observed that using the nature and its elements to express ourselves or using ourselves to explain the nature was quite an enjoyable process that internalizes the geography lesson. The philosophy of *to know people*

is to know the nature and to know the nature is to know people can be taken as a basis.

SUGGESTIONS

The following suggestions can be made as a result of the research;

- 1) A synectic study testing the effect of personal analogies on creativity can be designed.
- 2) Analogies can be classified based on different criteria such as types and levels of relationships.
- 3) Different techniques leading to misconceptions can be adapted to the subject and compared with the results of this study. Thus, the ability of personal analogies to reveal the mistakes will be tested.
- 4) Conceptual change theories can be used in order to eliminate the misconceptions.
- 5) It may be ensured that they get to know the rock masses, minerals and elements better in field trips and laboratory environments.

Conflict of Interests

The author has not declared any conflicts of interest.

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