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Models Usage in Teaching Astronomy and Visual Literacy

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Abstract
Visuals are used everywhere in our lives and are frequently used in educational environments. Scientific visualizations used in the educational environments can be a picture or a diagram or a TV show etc. Like the others, models are scientific visuals which are used for teaching science and especially in teaching astronomical concepts. If we talk about a visual, we should think about how we understand or re-create or teach the visual. Visual literacy is based on the idea that visuals can be "read". In the light of this knowledge, this study is aimed to present if there is a relation between the use of models in teaching astronomy and visual literacy. The significance of the study stems from its presenting connections between astronomy, models and visual literacy, which were not found in Turkish literature. For this purpose, the goals stated in Turkish National Science Program for 3, 4, 5, 6, 7 and 8th classes about models in astronomy were determined. And the goals were examined in the light of visual literacy. It is considered that visual literacy is important for understanding, analyzing and re-creating models which can be used for better science teaching and learning. It can be said that model usage in astronomy and visual literacy is connected.

Key words: visual literacy, astronomy, models, science education

Introduction

Visual objects have started to be put into use, starting from the time when human species appeared on the scene of the history of universe. Humans drew pictures on cave walls by reflecting their post-war victories or defeats, or by portraying other living things they saw, either for various reasons, that is, for expressing themselves. Various events, changes and developments that took place throughout the world in time have also caused people to change and to develop. The educational field, which is also in close interaction with social and economic fields, has, doubtlessly, been affected by these changes and developments. These developments, on the other hand, trigger technological and scientific developments. Educational programs are also constantly being changed and renewed under the effect of these technological and scientific developments that have the power to shift the direction of

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human life. The changes in educational programs also affect and change educational environments, which are an important part of the program. Following the World War II, the introduction of technology into educational environments and the use of technological materials besides various materials being used in educational environments can be shown as the evidence of this effect (Halis, 2002; Yanpar, 2007). Visual objects, such as advertisements, animations, graphics, pictures, and photos, which we come across today, as well, have been introduced as materials into educational environments.

As the result of the integration of the developing technology into educational environments, technological visual materials like television, computer and internet are being used in the education of sciences. The visualization work is applied in teaching concepts in the education of Sciences through the use of various materials, such as models, concept maps, simulations, and animations. When the materials in question are utilized effectively and relevantly by serving the purpose of the course, they provide various benefits, such as saving time and speech, leading complicated ideas towards simplification, increasing interest and attention, and allowing the teaching process to become lively and clear during the learning-teaching process (Halis, 2002; Gümüş et al., 2008). According to Çelik (2012), effective educational environments should be enriched with various materials, both classical and technological ones, due to the fact that such environments provide convenience and permanence in reaching the foreseen target.

One of the visual materials to be used in teaching the concepts in the Science Education is models. Models can be used in educational environments for the purposes of enriching the educational environments (Seçilmiş & Ünlüönen, 2011), making an unknown target become more clarified and comprehensible (Harrison, 2001; Treagust, Chittleborough & Mamila, 2002; Gülçiçek et al., 2003), turning an idea, an object, an event, or a process and a system into a visual form (Gilbert et al., 2000), turning the events that are unlikely to be carried into the class environment under normal conditions into something visual (Van Driel & Verloop, 1999; Gülçiçek & Güneş, 2004; Ünal & Ergin, 2006), making concepts more comprehensible and attainable (Duit 1991; Paton, 1996; Güneş, Gülçiçek & Bağcı, 2004), facilitating the learning process of concepts as well as making them permanent (Greca & Moreira, 2000; Justi & Gilbert, 2003; Gülçiçek et al., 2003; Günbatar & Sarı, 2005), and making generalizations (Olkun et al., 2010). According to Treagust et. Sl. (2002), on the other hand, the fact that concepts are abstract in the Science Education makes the usage of models in this course become essential. In the same way, according to the study conducted by Çiltaş and Işık in 2013, it is stated that the material to act as the interpreter in solving daily life problems is modeling. When the literature is reviewed, there are researches reporting that the use of models or modeling in various subjects in the science education has positive effects (Gülçiçek et al., 2003; Güneş & Çelikler, 2010; Canpolat et al., 2004; Sarıkaya et al., 2004; Günbatar & Sarı, 2005; Gümüş et al., 2008; Berber & Güzel, 2009).

Apart from various models that we come across in both educational process and in our daily lives, it is necessary to have a visually literate characteristic beyond the conventional literacy (Günay, 2008) so as to allow individuals to understand and utilize visual objects such as maps, diagrams, photographs and course books, since classical literacies are not sufficient in the classes where today's visual materials like graphics and computer are found (Flaum, u.d.). Therefore, extensive understanding as well as the re-constitution of the message conveyed by the models likely to be used in the science class, in other words, being literate in identifying a visual object is of importance. Within this context, it is the objective of this article to examine, by depending on the literature, the relationship between the use of models-modeling and visual literacy in teaching the concepts of astronomy included in the curriculum of the science courses of 3rd -8th Grades.

Literature of Misconceptions in Astronomy Education

Misconceptions in "Moons' Movement around the Earth" (Trumper, 2000; Frede, 2006; Kalkan & Kıroğlu, 2007; Türk, 2010; Şensoy, 2012), "Solar and Lunar Eclipses" (Kalkan & Kıroğlu, 2007; Kalkan et al., 2007; Bostan, 2008; Bayraktar, 2009; Türkoğlu et al., 2009; Türk, 2010; Şensoy et al., 2010; Şensoy, 2012), "Seasons" (Rollins et al., 1983; Baxter, 1989; Vosniadou, 1991; Sadler, 1992; Schoon, 1995; Sharp, 1996; Atwood & Atwood, 1996; Ojala, 1997; Dunlop, 2000; Trumper, 2000, 2001a, 2001b, 2006; Kikas, 2004; Frede, 2006; Kalkan & Kıroğlu, 2007; Küçüközer, 2007; Türkoğlu et al., 2009; Türk, 2010; Şensoy, 2012; Türk et al., 2012), "Earths Shape and Movement", (Klein, 1982; Lightman & Sadler 1988; Sneider & Pulos, 1983; Baxter 1989; Vosniadau & Brewer, 1989; Dove, 2002; Şensoy, 2012), "Distance and Size" (Türkoğlu et al. 2009; Küçüközer et al., 2010; Türk, 2010; Şensoy, 2012) concepts, which were in the program released by The Ministry of Education, Board of Education and Discipline (MEB, 2013).

- Phases of the Moon occur due to clouds covering the Moon.
- As long as the Sun moves, we see different parts of the Moon.
- The Moon's phases occur because the Moon gets into the Earths'/the Suns' shadow.
- The Moon revolves around the Earth in one day / one week.
- The Moons' surface is seen more as long as Earth rotates.
- Wind can move the Moon.
- In Solar Eclipses, the Full-moon phase is seen.
- The Sun is hotter in summer and colder in winter.
- The Earth rotates once a year. The Earth sees the Sun in summer, and the Moon in winter.
- The Sun revolves around the Earth.
- The temperature in summer and in winter differs because of the distance between the Earth and the Sun (The Distance Theory).
- The Earth revolves around the Sun, because of that, day and night occurs.
- The Earth's shape is as a closed disc/ellipse.
- The center of the universe is the Sun / the Milky Way Galaxy.
- The Earth is bigger than Jupiter.
- Pluto is closer to the Earth than the Sun.
- Satellites are closer to the Moon than the Earth.

There are some studies found in the literature about the model usage and modeling being effective while teaching these concepts and motivating the students (Baxter & Preece, 1999; Barab et al., 2000; Dede, 2000; Yairet al., 2001; Keating et al., 2002; Hansen et al., 2004; Barnett et al., 2005; Shen & Confrey, 2008; Bell & Trundle, 2008; Frede, 2008; Küçüközer, 2008; Küçüközer et al., 2009; Fidler & Dotger, 2010; Hobson et al., 2010; Trundle & Bell, 2010; Yusofi & Mohsenzadeh, 2010; Gilbert ve Justi, 2016). So, these concepts were examined in the light of the model usage and modeling.

Literature Regarding the Visual Literacy in the Subjects of Science

When the national literature is reviewed, there are separate studies regarding 'scientific literacy', 'visual literacy', or the subjects about visual tools. Very few academic studies have been found in national and international publications in relation to 'visual literacy in science' or 'visual literacy of science' in associating visual literacy with science. When the national literature is reviewed on the basis of the article, no study in which the subjects of science were examined in the spotlight of visual literacy has been found. When the webpage of The Dissertation Center of the Presidency of Higher Education Council was reviewed, 12 dissertations related to visual literacy was found. 6 of these dissertations are on the level of master's degree (Güleryüz, 1996; Kıran, 2008; Kuvvetli, 2008; Seğmen, 2013; Çakıroğlu, 2014; Doğru, 2014), while 6 of them are on the doctorate level (Anafarta, 2001; Parsa, 2004; Aslan, 2012; Keskinkılıç, 2014; Özkubat, 2015; Yerlikaya, 2015). When the dissertations in question are reviewed, it is seen that visual literacy is associated with artistic fields, radio and television, grammar education, education of the social sciences course and mathematics. Within this context, no dissertation associated with science education or science and technology has been found.

When the international literature is reviewed, one of the studies found is the article written by Slater et al. (2010). In this article was visual literacy associated with astronomy. According to this study, it was stated that the students receiving astronomy courses were under the bombardment of several graphics, simulations, images, tables and films, due to which the education of astronomy could turn into reality for the students who learned visually. In the study conducted by Watkins et al. (2004), it was asked whether the visual material had posed any change in the learning process in science education, and it was also proposed that it was necessary to investigate what it changed if it changed anything. Arpaguş et al. (2011) on the other hand, collected data through a multiple-choice scale applied to the experimental and control groups for the purpose of investigating the effect of visual reading on the success attained by secondary school students over spherical mirrors and lenses. The course was taught to the experimental group through the visual reading-weighted method based on graphics and shapes, whereas the control group received this course through the conventional method. As the result of the obtained data, it was concluded that the method based mainly on visual reading had proved to be more effective. Another study in the literature is about how teachers apply visuals found in science books during the educational process. For this, 2-dimensional visual models were preferred. It was pointed out that teachers needed to be more careful about visual models and to know how to support their students at the point of visual literacy (Oliveira et al., 2013).

In their study, Yeh and McTigue (2009) stated that visual demonstrations, particularly the diagrams, were used for visually identifying very large scale or very small scale concepts found in science. Anthony et al. (2010) in their article, examined the visuals such as photographs and diagrams included in the curriculum of science course within the context of visual literacy. Within the project carried out in this context, it was stated that visual literacy strategies were focused on during the courses in which explanations were made by using powerpoint presentations. A case study through a computer-based model was conducted by Waight et al. (2014). During the concept teaching done in the high school-level chemistry course, the role of models as tools were highlighted. The data were collected through the interview made between students and teachers, in-class observations and the notes taken by the researcher. It was noted that the model, modelling process as well as the pedagogical content knowledge of the teacher and the consistency of the student's knowledge were important in reading the model. Apart from this, it was emphasized that literacy had a major role in reading and understanding the model as well as turning it into verbalism. Mnguni (2014) stated that visual models, such as diagrams, animations and photographs, were important due to the fact that the concepts in science education are rather complicated and interwoven, and that the role of visual literacy in the constitution of knowledge in science education was not adequately studied on. In this study, the cognitive process in visualization and in perceiving the visual for the education of science was discussed.

Visual Literacy

When the word groups constituting visual literacy are examined, the word 'visual' indicates to the hypothesis that communication can be established by looking at the hieroglyphics, whereas the word 'literacy' indicates to the hypothesis that reading and writing, in other words, formation could be established (Brill et al., 2007). The concept of literacy formed when the words 'visual, reading and writing' were followed by one another came to the fore after the second half of 20th century (Aslan, 2009). This concept was first brought forward by Debes in 1969 (Ivla, 2012). There is still not a single definition of visual literacy although it has been accepted as a concept (Brill et al., 2007). According to International Visual Literacy Association (IVLA), the reason why there are so many definitions for literacy is associated with the fact that visual literacy is connected with several fields and that each definition made is in compliance with the field it refers to. The definition of visual literacy is seen in the Ivla's official webpage as the definition made by Debes in 1969:

> "… Visual Literacy refers to a group of vision-competencies a human being can develop by seeing and at the same time having and integrating other sensory experiences. The development of these competencies is fundamental to normal human learning. When developed, they enable a visually literate person to discriminate and interpret the visible actions, objects, symbols, natural or man-made, that he encounters in his environment. Through the creative use of these competencies, he is able to communicate with others. Through the appreciative use of these competencies, he is able to comprehend and enjoy the masterworks of visual communication …"

> And Philip Yenawind (1990) defined visual literacy as:
> "... the ability to find meaning in imagery. It involves a set of skills ranging from simple identification—naming what one sees—to complex interpretation on contextual, metaphoric, and philosophical levels. Many aspects of cognition are called upon, such as personal association, questioning, speculating, analyzing, fact-finding, and categorizing. Objective understanding is the premise of much of this literacy, but subjective and affective aspects of knowing are equally important …"

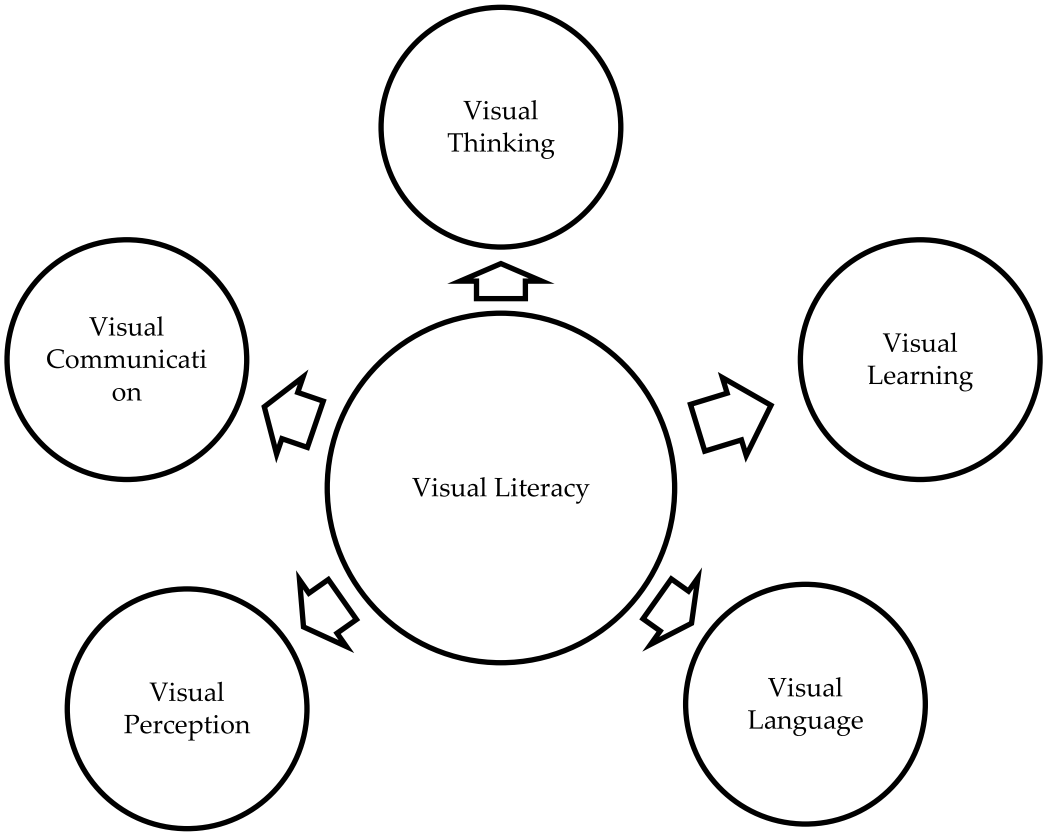
As conveyed by Stokes (2002), Wilemen (1993) defined visual literacy as the ability to read, understand and interpret the graphic or the information illustrated. According to İpek (2003), another definition of visual literacy within this context was made by Fransecky and Debes (1972) as "the group of visual abilities of an individual at the moment of seeing and those developed through other sensory experiences". While, in some definitions, visual literacy is discussed as a learnable proficiency, in some others, it is stated to be an ability/talent. Another point which distinguishes the definitions from one another attracts attention. In some definitions, visual literacy is defined only as reading, understanding and interpreting the visual; whereas in some others, we also come across the creation/constitution of the visual besides these.

According to MacGregor (2002), visual literacy has two focuses: The first one is to deal with perceiving the visuals as well as making sense out of them; whereas the other is to establish a communication and a visual with the help of visuals. In order to understand what the visuals aiming at transferring or organizing information try to tell us, it is necessary to read and write the visuals. According to Branton (1999) and Emery and Flood (1998) derived from Stokes (2002) visual literacy has a language unique to itself, which is used to understand and interpret the message required to be conveyed through the visual tool. According to İşler (2002), the communicative style used in visual literacy is a 'language' different from and independent of the oral narrative style, and everything in visual literacy is done through seeing. Learning the language of what is visual, in other words, becoming a visually literate person has, today, become as important as the literacy of what is written (Kiper et al., 2012). The taxonomy of the visual language was required since visual stuff are also capable of telling people various things that cannot be explained verbally. Taxonomy of visual literacy suggested by Brill et al. (2007) is:

- Visualizing the visceral
- Visualizing heuristics
- Visualizing algorithms
- Visualizing procedures
- Visualizing concepts
- Visualizing abstract notions

Emphasizing the fact that visual literacy has a language and that this language is parallel to the verbal language, Avgerinou (2011) demonstrated the components of visual literacy through a diagram (See: Figure 1). Separately, Avgerinou (2011) states that visual literacy is a learnable, teachable and improvable skill. An individual having such a skill, according to Orhon (2011), should be able to understand the visual piece or the subject of the whole, to comprehend and interpret the semantic strata s/he has gained and adopted within the cultural structure s/he lives in; in addition, s/he should be able to evaluate the style and the order in terms of the visual structure, to examine the techniques used in the production of the visuals, to evaluate their aesthetic value, purpose and target population and to be able to discuss the synergy, interaction, innovation, and the effective aspect put forward as well as how they make her/him feel. According to Işler (2002), visually-literate individuals perceive and interpret the visual messages and can produce effective visual messages by using conventional methods, computer or other technologies.

Figure 1. Conceptual Components of Theory of Visual Literacy (Avgerinou, 2011).



Visualization Methods

Verbal, digital and other types of presentations are applied in the educational environments for the science education (Pauwels, 2006). Visualization has become significant particularly in the science education (Ernst & Clark, 2009). In the official webpage of Ivla, the periodic table of visualization methods which involve some of the materials to be used in the course and which were created by Lengler and Eppler (2014) was published (See: Table 1). In this table, the methods to be applied in visualization were visualized and were presented to the involved reader. According to this table, the visualization methods are as follows (Lengler & Eppler, 2014):

- Data Visualization: It is the visual presentation of the quantitative data in a schematic form. Data visualization is used for the visuals, such as tables, pie-slice graphics, line charts, cartesian coordinates, bar graph, area chart, scatterplot, histogram, and spectrogram.
- Information Visualization: This is the usage of interactive visual presentations. It is formed by transferring the data into visual form as well as mapping the data and displaying them on the screen. The visual item should be capable of being modified by the user while the user is working with it. The visualization of information is the form of representation in which the visuals, such as radar chart, cycle diagram, venn diagram, timetable, sankey diagram, entity-relationship diagram, flow chart,

clustering, data map, system dynamic modeling, data-flow diagram and semantic net, are used.

- Concept Visualization: This is mostly the work of elaborating the qualitative concepts, ideas, plans and analyses. As far as the visualization of a concept is concerned, what comes to mind is that the visuals, such as mind map, anti-square, mass venn (concentric circles), layer chart, soft systems methodology (SSM), synergy map, forcefield diagram, communication diagram, flight plan, decision tree diagram, process-event diagram, critical path method, vee diagram and concept map, are used.
- Strategy Visualization: This is the systematic use of complementary visual representations in the analysis, development, formulation, communication and practice of the strategies applied within organizations. On the other hand, the visuals such as supply-demand graphics, strategy map, organization chart, House of Quality, life cycle diagram, Porter's 5 forces analysis, fishbone diagram, and growth-share matrix are the examples of strategy visualization.
- Metaphor Visualization: Visual metaphors are used to position the place and structure of the information. Separately, these visual metaphors develop an insight through the main characters used within the metaphor with respect to the represented information. Metaphor visualization is used in the visuals, such as the route maps of the means of transport, story template, funnel diagram, tree diagram, and iceberg diagram.
- Compound Visualization: It is the complementary use of different graphic representations expressed within a single schema or in a single way. The examples to this type of visualization are caricatures, knowledge mapping, learning map, or the visuals referred to as 'graphic facilitation' and 'rich picture' in the literature, which are formed by turning various writings and shapes into a map.

Methodology

This study is an exploratory research due to the fact that it explores the basic realities about the topics on which no adequate number of studies have been conducted before and also due to the fact that it is the study that formulates the research topics for prospective studies and guides the way for future studies through its findings (Böke, 2009, p.13). This study has a qualitative perspective. Through this perspective, the curriculum of the science education courses of 3rd -8th Grades was examined, and the document analysis was performed. As stated by Karasar (2010), the document analysis defined by Rummel (1968) and by many other people as ''the document method'' is expressed by Duverger (1973) as the ''documentary observation'', again, as stated by Karasar. The document analysis involves the analysis of the written materials containing information about the events or cases targeted to be investigated (Yıldırım & Şimşek, 2008). While acquisitions were being examined, particular attention was paid to what the expressions found within their attributions were. It was determined whether or not the expressions had corresponded to the steps of visual literacy, and if they did, which of them the expressions had corresponded to was ascertained.

Findings

Concepts of Astronomy and Visual Literacy Included in the Curriculum

The current science education program (MEB, 2013) was examined in the spotlight of the acquisitions related to the models under the topic heading ‘astronomy education’’. Astronomy education is included under the subject-focus title of ‘’The Earth and The Universe’’, and the chapters regarding this subject focus consist of several sections on some class levels. It is included within the curriculum with different contents and different chapter headings on the level of 3rd and 8th Grades. The acquisitions included in the curriculum as well as class levels, chapter numbers and chapter names are given in the involved Table 2.

Table 2. Grades, Units, Sections, Goals and Acquisitions Which Has Acquisitions Related to Modals and Modelling in Astronomy Topics (MEB, 2013)

Subject Area: **Earth and Universe**			
3rd Grade	**6th Grade**	**7th grade**	**8th grade**
7. Unit: Lets Recognize Our Earth	8. Unit: Our Earth, Moon and Life Source Sun	7. Unit: Solar System and Beyond	8. Unit: Earthquake and Weather events
GOALS			
It is targeted that the areas covered by lands and waters be compared by comprehending the fact that there are lands and waters at the surface of the earth and there is an air layer surrounding us.	It is aimed that the students get to know and apprehend the relative dimensions /sizes and shapes of the Earth, the Sun and the Moon, become capable of creating a model by explaining the rotational and revolving movements of the Moon, be able to establish a movement relationship between the Earth and the Moon, and acquire information and skills as to the consequences caused by this relationship and its effect on the daily life.	In this chapter, it is aimed that the students have knowledge of celestial bodies, that they understand the system concept, apprehend the importance of the telescope in astronomy since it is a significant observational tool and acquire information and skills as to the contributions made by space researches without ignoring the technological dimension.	… Separately, it is targeted that the students acquire information and skills as to the causes of weather events occurring in the atmosphere, their types, how weather forecasts are performed and also climate and global climatic changes.
2nd Section **The Structure of the Earth**	1st Section **The Comparison of the Shapes and the Measurements of the Earth, the Sun and the Moon**	2nd Section **The Solar System**	3rd Section **The Evolution of the Seasons**
Acquisitions: -The students compare the areas covered by lands and waters at the surface of the earth on a model.	**Acquisitions:** -They compare the shapes and sizes of the Earth, the Sun and the Moon by using the model they have created. (While comparing the sizes, no numeric data are used; only the sizes of these bodies according to one another are taken as the basis).	**Acquisitions:** -They create and present a model by putting in order the planets within the solar system according to their proximity to the Sun. (It is also pointed out that the space islands made up of billions of celestial bodies are called 'a galaxy' and that the Solar system is located in the galaxy referred to as 'The Milky Way'). -They compare the planets within the solar system. (a. In the comparison of the planets, their sizes according to one another, the number of natural satellites, and whether or not the planets have rings around them are all taken into consideration. b. Based on the galaxy they are located in as well as the order of the system and the proximity of the bodies to the Sun, the place of our earth in the cosmos is identified).	**Acquisitions:** -They identify the cause of the formation of seasons with the obliquity of the earth's rotational axis and with the earth's rotation around the Sun. -By taking into account the obliquity of the earth's rotational axis, they create and present a model pertaining to the revolving movement of the earth around the Sun.
	2nd Section **The Layer Model of the Earth**		
	Acquisition: -They explain the layer model representing the structure of the earth and compare these layers according to their general characteristics. (In this comparison, the main characteristics are taken as the basis; no detail, such as temperature, thickness, etc., is given).		
	3rd Section **The Moon the Satelite and the Earth**		
	Acquisition: -They create and present a representative model as to the movements of the Moon by expressing the fact that the Moon, while rotating around itself, also revolves around the Earth. (The Moon is stated to be the satellite of the Earth).		

When the involved Table was reviewed, the following findings were achieved:

- When the acquisitions regarding the concepts of astronomy were reviewed, acquisitions related to modeling were seen in 3rd, 6th, 7th, and 8th grades. There is no acquisition found with respect to modeling in 4th and 5th grades.
- When the statements pertaining to the acquisitions as to the application of modeling were examined; it is expected that a comparison over the exisiting model be made rather than creating a model on 3rd Grade level. On 6th Grade level, however, students are expected to both make comparisons by benefiting from the model and create and present their model, as well. When they attain 7th and 8th Grade levels, they are expected to create and present a model. Within this context, it can be said that the modeling acquisitions included in the curriculum are appropriate for the cognitive developmental stages of the students.
- In Acquisitions, these statements are included: “they compare these over the model’’, ‘’they explain the model’’, and ‘’they create and present a model’’. The students are supposed to perform each step by first understanding the facts regarding the model (the statement about comparison), then they need to transfer the information (the statement about explanation), and then they are supposed to create the model (the statement about creating a model), and finally, they need to share their model (the statement about presentation).

Results and Suggestions

In visualizing the concepts and abstract concepts in the education of physical sciences, many materials in the class environment or outside the school can be utilized. These materials, as well as being the visuals such as presentation, slideshows, photographs, illustrations, mind maps, and concept maps, can also be used on models and in the modeling process. It is thought that within an educational environment where concepts are explained through visualization, being capable of reading the visual codes of an object or objects in an extensive way will be of great use at the point of understanding that concept or the group of concepts. When the curriculum is reviewed, the subjects regarding the concepts of astronomy are included under the topic-focused heading, “The Earth and The Universe” MEB (2013). When the acquisitions pertaining to this topic focus are reviewed, the expressions, “creating and presenting a model, making comparisons over the model, and explaining the model” have been used. When the acquisitions in relation to the concepts of astronomy included in the curriculum are reviewed, the relationship between the usage of a model and visual literacy can be expressed as follows:

- Explaining the Model **(Understanding - Perceiving the Visual Object)**
- Making a Comparison over the Model **(Interpreting the Visual Object)**
- Creating and Presenting the Model **(Creating the Visual Object)**

It is required that the visual (model) in question be understood and perceived in order to explain the model. It is impossible to explain a visual which cannot be perceived or understood. It can be stated that it is necessary to be able to interpret the visual (model) so as to make a comparison over the model in the succeeding stage; however, comparisons can be made at the interpretation stage. Creating the model, however, will require a separate mental process. It can be said that it is necessary to be in a state of having understood the concept (visual) in the first place and then having interpreted it right after in order to create the visual (model). Following these processes, the process of creation begins, and eventually, after having created the concept (visual), individual processes are left behind at the point of presenting the concept to other individuals, and then the social communication begins.

It can be thought that owing to the visual features of the models used for education in class environments, visual literacy is of importance in order for the comprehension, explanation and creation processes and actions to be fully fulfilled. When this context is taken into consideration, model and education can be said to be associated with visual literacy skill. It can also be stated that visual literacy is required in every field.

When visualization methods are reviewed, it can be said that all methods can be applied for modeling, as well. When the acquisitions included in the study are reviewed within the context of visualization methods, it can be seen that the visualization of information as well as the visualization of contexts are intensively used. Graphics, schemas, diagrams, caricatures, two-dimensional or three-dimensional shapes are the examples of a model (Güneş et al., 2004). Thus, model teaching studies can be conducted along with teachers and students by teaching visualization methods. Developing the education of visual literacy during the educational process, in other words, improving individuals' skills on identifying a visual message as well as decoding, interpreting, evaluating and re-building that message (Yerlikaya, 2015), and also developing reading-writing skills of students by using visual images are possible through the educational programs that provide an opportunity in this subject (Zeren & Arslan, 2009). It can be thought that when students learn the language of visual literacy and also learn to develop their proficiency in this besides various literacies to be included in these programs, they will have the chance to be able to understand, interpret and create all the messages desired to be conveyed visually. According to Alpan (2008), visual literacy is a perceptional action like other literacies within the context of thinking and the way of establishing a communication as well as seeing the images and being able to make sense out of them. This perceptional action and the use of visual proficiencies in a creative manner suggest that students will become individuals capable of establishing more effective communications in social life, as well. As the proficiency of an individual increases in the field of visual literacy, her/his ability to solve new problems confronted in the field of physical sciences is also thought to increase, especially when it is considered that her/his direction in critical thinking against visuals will improve. Due to the visual features of the models likely to be used for educational purposes in physical science courses, it can be thought that visual literacy is of importance in terms of understanding extensively the message desired to be conveyed, for being able to analyze it and for re-creating it. It can be stated that the education of the concepts of astronomy is associated with visual literacy skill through the use of a model. It is thought that while education is provided through both two-dimensional and three-dimensional models recommended to be used in teaching the concepts of astronomy, it is required that the effects of having a visual literacy skill be put forward, as well.

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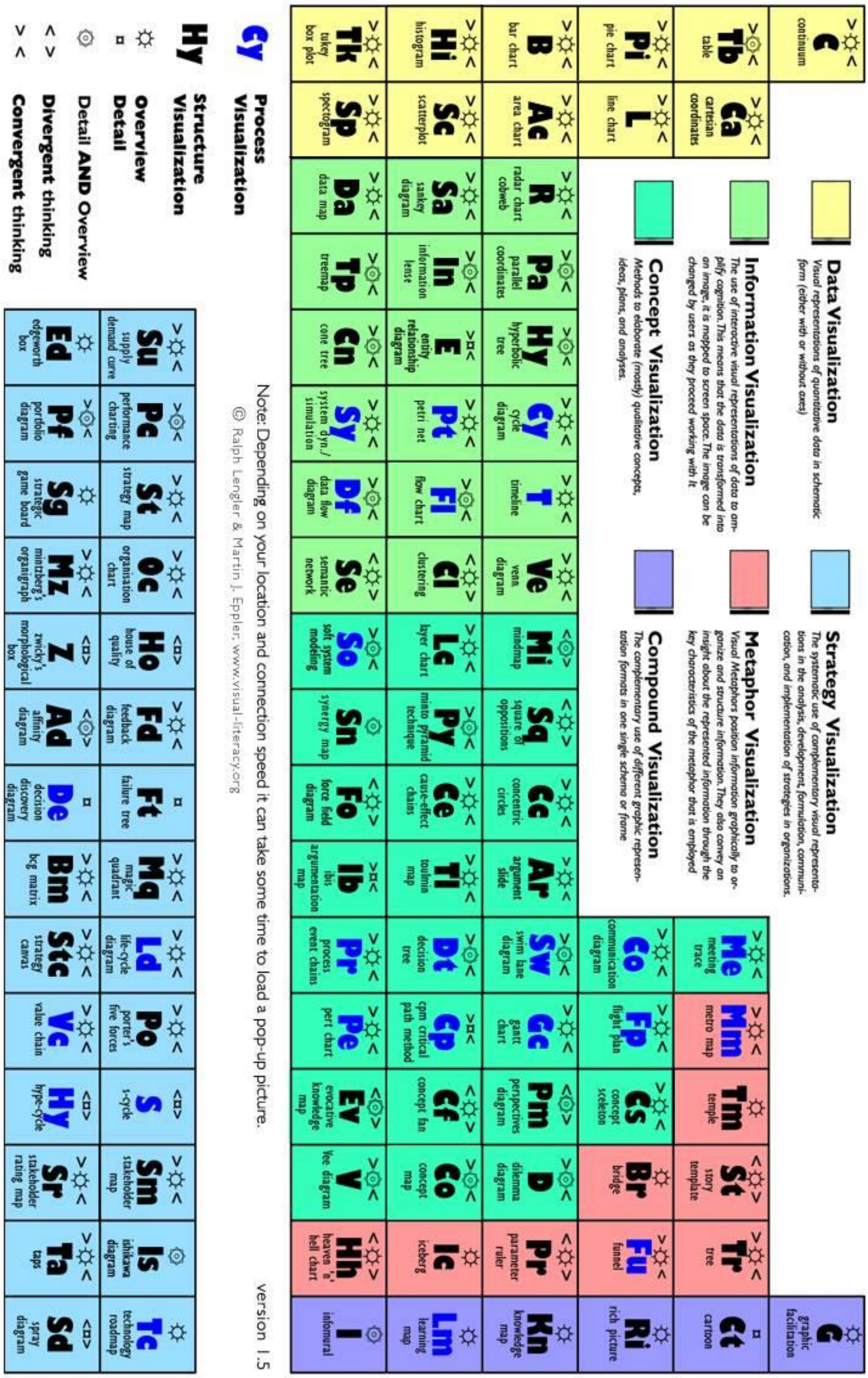
A PERIODIC TABLE OF VISUALIZATION METHODS
Data Visualization
Visual representations of quantitative data in schematic form (either with or without axes)
Information Visualization
Concept Visualization
Methods to elaborate (mostly) qualitative concepts, ideas, plans, and analyses.
Strategy Visualization
Metaphor Visualization
Compound Visualization
The complementary use of different graphic representation formats in one single schema or frame
Process Visualization
Structure Visualization
Overview
Detail
Detail AND Overview
Divergent thinking
Convergent thinking
Note: Depending on your location and connection speed it can take some time to load a pop-up picture.
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