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Araştırma Makalesi /Research Article

Öğretmen Adaylarının Öğrenme Stillerinin Şematik Not Hazırlamalarına Etkisi

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Özet– Araştırmanın amacı öğretmen adaylarının öğrenme stillerinin fen konularında hazırladıkları şematik notlara etkisini belirlemek ve şematik notlarda kullandıkları görsel ve yazılı öğelerin kullanım amaçlarını tespit etmektir. Araştırma betimsel ilişkisel tarama modeli esas alınarak yürütülmüştür. Araştırmaya Alanya Alaaddin Keykubat Üniversitesinde ikinci ve üçüncü sınıfta öğrenim gören 44 fen bilgisi öğretmen adayı katılmıştır. Veriler Akgün ve ark. (2014) tarafından hazırlanan "Sözel veya Görsel Baskın Öğrenme Stilini Belirleme Ölçeği" ve katılımcıların ortaokul fen konularında hazırladıkları şematik notlarla toplanmıştır. Elde edilen sonuçlara göre katılımcıların çoğunluğunun baskın öğrenme stili görseldir. Görsel öğrenme stili baskın olanlar şematik notlarında sıklıkla çizim ve farklı yazı stilleri ile görselliği ön plana çıkarırken, sözel öğrenme stili baskın olanlar kelime ve cümleleri daha fazla tercih ederek detaylı açıklama yapmışlardır. Görsel öğrenme stili baskın olanların süreç oluşturma, gruplama ve listelemeye, sözel öğrenme stili baskın olanların açıklamaya daha fazla önem verdikleri tespit edilmiştir. Sonuçlar ışığında şematik notların öğretmenlere tanıtılması, öğrenme ve öğretme sürecinde kullanılması önerilmektedir.

Anahtar kelimeler: Öğrenme stili, görsel ve sözel öğrenme, fen öğretim materyalleri, şematik notlar, fen bilgisi öğretmen adayı.

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Geniş Özet

Giriş

Bilişsel öğrenme kuramı ile birlikte araştırmacılar bireyin öğrenme sürecindeki özellikleriyle ilgilenmeye başlamışlardır. Öğrenenlerin bilgiyi nasıl öğrenmeyi seçtiğini, bireye özgü özelliklerin bu seçimlerini nasıl etkilediğini sorgulamışlar (Morgan 1997), öğrenenlerin öğrenmeyi gerçekleştirmek için tercih ettikleri yolları belirlemeyi amaçlamışlardır. Bireylerin özelliklerini (Kolb, 1988), biyolojik (Dunn & Dunn, 1993) ve sosyal (Grasha, 1996) açılardan ele alarak öğrenme stillerini tespit etmişlerdir. Farklı öğrenme stilleri araştırmacıları bireysel öğrenme türlerini araştırmaya yöneltmiştir. Öğrenme türlerini görsel ve sözel başta olmak üzere farklı gruplarda incelemişlerdir. Görsel öğrenme, görsel olgularla etkileşim sonucu bilginin yapılandırılmasıdır (Seels, 1994). Resim, grafik, tablo veya çizimler görsel öğrenenlerin soyut kavramları somutlaştırmalarını ve kavramlar arasında ilişki kurmalarını kolaylaştıran görsel materyallerdir. Sözel öğrenme, bilginin sözel ve yazılı formlar aracılığıyla yapılandırılmasıdır. Konuşma, yazma veya okuma aktiviteleri sözel öğrenenler için önemlidir. Geleneksel sınıflarda dinleme, okuma, not alma etkinliklerinde sözel öğrenme baskındır (Armstrong, 2009). Görsel ve sözel öğrenme stiline sahip öğrencilere kullanabilecek öğretim materyallerinden birisi de şematik notlardır. Şematik notlar, bir metni okurken, bir konuşmayı dinlerken ya da bir işi organize ederken oluşturulan görsel hikâyelerdir. Yazı, çizim, şekil, sayı, işaretler gibi görsel ve yazılı öğeleri içerir (Rohde, 2013). Fen öğretiminde kullanımı yaygınlaşan şematik notlar, kavram öğretiminin yanı sıra bilimsel açıklamaların karmaşıklığını azaltmak ve problem çözme sürecinde kavramsal düşünmeyi tanıtmak için de kullanılmaktadır (Fernandez-Fontecha et al., 2018). Bilgilerin ilişkilendirilmesi, paylaşılması, hayal gücünün ve soyut düşünme becerilerin geliştirilmesi için kullanışlı araçlardır (Bratash, Riekhakaynen, & Petrova, 2020).

Araştırmanın amacı

Şematik notlar görsel ve yazılı öğeleri bir arada içerdiğinden, farklı öğrenme stiline sahip öğrencilerin ilgisini çekebilecek, not alma, planlama, özetleme, değerlendirme gibi farklı öğretimsel amaçlar için kullanabilecek öğretim materyalidir. Literatürde şematik notların hazırlanmasını (Rohde, 2013), kullanım amaçlarını (Altieri, 2017; Robinson 2018; Fernandez-Fontecha et al., 2018) ve fen öğretimindeki uygulamalarını (Enfield, Smith, & Grueber, 2008; Forbus, et al., 2011; Bratash, Riekhakaynen, & Petrova, 2020) tanıtan araştırmalar yer almaktadır. Şematik notların öğretimde kullanılmasına yönelik araştırmaların yaklaşık 10 yıldır yapıldığı ve bu konunun araştırmacıların son yıllarda daha fazla ilgisini çektiği görülmektedir. Ülkemizde şematik notların fen öğretiminde kullanıldığı ve öğrenmeye etkisinin analiz edildiği bir araştırmaya rastlanmamıştır. Bu araştırma eğitimcilere yeni bir bakış açısı sağlayabilir.

Ayrıca literatürde farklı öğrenme stillerine sahip öğrencilerin şematik notları nasıl kullandıklarına dair araştırma bulunmamaktadır. Bu araştırmanın amacı öğretmen adaylarının öğrenme stillerinin fen konularında hazırladıkları şematik notlara etkisini incelemektir. Bu amaçtan hareketle öğretmen adaylarının baskın öğrenme stilleri belirlenmiş, bunun şematik notlarındaki görsel ve yazılı öğelerin kullanımına etkisi araştırılmıştır. Ayrıca şematik notlarda yer alan görsel ve yazılı öğelerin kullanım amaçları incelenmiştir. Elde edilen sonuçlar farklı öğrenme stiline sahip öğrencilere yapılacak öğretimde şematik notların nasıl ve hangi amaçlarla kullanılabileceği konusunda eğitimcilere yol gösterebilir.

Yöntem

Bu araştırma öğretmen adaylarının baskın öğrenme stillerinin şematik not hazırlamalarına etkisini ortaya koyduğundan betimsel nitelikte ilişkisel tarama modelindedir.

Katılımcılar: Araştırmaya Alanya Alaaddin Keykubat Üniversitesinde ikinci ve üçüncü sınıfta öğrenim gören 44 fen bilgisi öğretmen adayı katılmıştır.

Veri toplama araçları: Katılımcıların görsel veya sözel baskın öğrenme stilini belirlemek üzere Childers, Houston ve Heckler (1985) tarafından geliştirilmiş ve Akgün, Küçük, Çukurbaşı ve Tonbuloğlu (2014) tarafından Türkçeye uyarlanmış olan "Sözel veya Görsel Baskın Öğrenme Stilini Belirleme Ölçeği" kullanılmıştır. Uyarlanan ölçek sözel ve görsel öğrenme stilleri olmak üzere iki alt boyuttan ve 16 maddeden oluşmaktadır. Araştırmanın diğer veri toplama aracı katılımcıların hazırladıkları şematik notlardır. Öğretmen adayları ortaokul düzeyinde istedikleri bir fen konusunu açıklamak için görsel ve yazılı öğeleri kullanarak şematik not oluşturmuşlardır.

Verilerin analizi: Katılımcıların baskın öğrenme stillerini belirlemek ve öğrenme stillerinin şematik notlarda kullandıkları görsel ve yazılı öğelere etkisini analiz edebilmek için betimsel ve karşılaştırma testleri kullanılmıştır. Şematik notların araştırmacılar tarafından hazırlanan kontrol listesi ile içerik analizi yapılmıştır.

Bulgular

Katılımcıların 34'ünün (%77.2) baskın öğrenme stili görsel, yedisinin (%16) sözeldir. Üç (%6.8) katılımcı ise ölçeğin alt boyutlarından eşit puan aldıkları için her iki öğrenme stili de baskındır. Tüm katılımcıların şematik notlarında çizim, madde işareti ve yazı stiline dikkat ettikleri tespit edilmiştir. Şematik notlarda en az kullanılan görseller tablolardır. Görsel öğrenme stili baskın katılımcılar şematik notlarında diğer katılımcılara oranla şekil, tablo, grafik ve diyagramları daha fazla kullanmışlardır. Dikkat çekici bir bulgu olarak, sözel öğrenme stili baskın olan katılımcılar şematik notlarında tablo ve grafiklere hiç yer vermemişlerdir. Tüm

katılımcılar şematik notlarında başlık ve cümlelere (kısa açıklamalar) yer vermişlerdir. Sözel öğrenme stili baskın olan katılımcılar diğerlerine oranla konuyu alt başlıklar oluşturarak açıklamayı daha fazla tercih etmişlerdir. Bunun yanı sıra konuşma balonu ve bilgi kutularını diğerlerine oranla daha sık kullanmışlardır. Hem görsel hem de sözel öğrenme stili baskın olan katılımcıların tümü şematik notlarında yazılı semboller kullanmışlardır. Katılımcıların yazılı ve görsel öğeleri kullanım amaçları incelendiğinde, konuyu açıklamak ve önemli noktaları vurgulamak için tümünün bu öğeleri kullandıkları tespit edilmiştir. Ayrıca hepsi kavramları maddeler halinde açıklamak için listeleme yapmayı tercih etmişlerdir. Kelime, cümle ve çizimler açıklama, yazı stili ve renk vurgulama, madde işareti ve oklar listeleme için en sık kullanılan öğelerdir. Görsel-sözel öğrenme stili eşit olan katılımcıların tümü şematik notlarında organizasyona dikkat etmiş, bilgileri organize etmek için kullandıkları kâğıdı ya çizgilerle bölmüş ya da tablo, grafik ve diyagramlarla bilgileri açıklamışlardır. Ayrıca benzetim yapmak için çizim ve kelimeleri kullanmışlardır. Süreç oluşturarak konuyu açıklamayı en sık tercih edenler görsel öğrenme stili baskın olanlardır. Ayrıca bu gruptakiler diğerlerine oranla kavramları eşleştirmeyi, yazılı ve görsel öğeyi ilişkilendirip açıklamayı tercih etmişlerdir. Sözel öğrenme stili baskın olanlar ise konuyu açıklarken örnekler vermeyi diğerlerine oranla daha fazla tercih etmişlerdir. Katılımcıların öğrenme stillerine göre görsel öğeleri kullanımları incelendiğinde, görsel öğrenme stili baskın olanlar ile diğer gruplardakiler arasında görsel öğrenenlerin lehine anlamlı fark bulunmaktadır. Yazılı öğeleri kullanımları incelendiğinde, sözel öğrenme stili baskın olanlar ile diğer gruplardakiler arasında sözel öğrenme stili baskın olanlar lehine anlamlı fark bulunmaktadır.

Sonuç ve Tartışma

Katılımcıların çoğunluğunun görsel öğrenme stili baskındır. Bu durum derslerde görsel öğelerin sıklıkla kullanımını gerektirmektedir. Ancak Armstrong (2009) tarafından belirtildiği gibi derslerde konu öğretimi sıklıkla sözel olarak yapılmaktadır. Bu durum birçok öğrencinin derslerden verimli olarak yararlanmadığını göstermektedir. Etkili öğrenmek için bilgilerin hem görsel hem sözel hem de yazılı sunumuna yer verilmelidir (Felder, 1993). Bu durumda hem görsel hem de sözel öğrenme stili baskın öğrenciler daha anlamlı şekilde öğrenebilirler. Katılımcıların öğrenme stili şematik notlarda kullandıkları görsel ve yazılı öğeleri etkilemektedir. Fleming'e (2001) göre görsel öğrenenler konuları öğrenirken harita, grafik, tablo, şema, farklı yazı tipi ve renkleri, resimler gibi öğeleri kullanmayı tercih etmektedirler. Sözel öğrenenler ise yeni bilgilerini açıklamaktan, tartışmaktan, hikâye yazarak anlatmaktan hoşlanmaktadırlar. Okuyarak/yazarak öğrenenler ise listeleme, rapor yazma, not alma, Web sayfaları hazırlama gibi etkinliklerle öğrenmeyi tercih etmektedirler. Bu araştırmada da görsel

öğrenme stili baskın olanlar şematik notlarında şekil, tablo, grafik, diyagram gibi görsel öğeleri sıklıkla kullanmışlardır. Bilgileri organize etmede ve sayfa düzenlemesinde renklendirme, yazı stilleri ve çizimlerin kullanımı dikkat çekmektedir. Sözel öğrenme stili baskın olanlar ise tanımlama ve açıklamaları bilgi notu, konuşma balonu, cümle ve kelimeleri kullanarak yapmışlardır. Pritchard (2009) görsel-sözel öğrenenlerin grafik, diyagram ve çizimlerin yanı sıra bilgiyi yazılı ifadelerle açıklamakta, her iki kaynağı da kullandıklarını belirtmektedir. Bu araştırmaya katılan ve görsel-sözel öğrenme stili eşit olanlarında görsel öğeleri sözel öğrenme stili baskın olanlardan, yazılı öğeleri de görsel öğrenme stili baskın olanlardan daha fazla kullanmaları avantajlı bir durumdur. Araştırmanın diğer önemli sonucu da, şematik notlardaki görsel ve yazılı öğelerin kullanım amacı ile ilgilidir. Görsel öğrenme stili baskın olanlar kavramları ilişkilendirme, sözel öğrenme stili baskın olanlar örnekleme, görsel-sözel öğrenme stili eşit olanlar ise benzetimlerle açıklamaya ağırlık vermişlerdir. Bu çalışmada farklı öğrenme stiline sahip bireylerin şematik notlarında bilgiyi zihinlerinde nasıl organize ettikleri, kavramları nasıl ilişkilendirip açıkladıkları ortaya konmaktadır.

The Effects of Learning Styles of Pre-service Teachers on Their Sketchnotes Designs

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Abstract –The study aims to investigate the effect of the pre-service teachers' dominant learning styles on their sketchnotes designs prepared for science topics as well as determining their reasons for the visual and written elements used in these sketchnotes. The study was designed following descriptive correlational survey model. The participants consisted of 44 teacher pre-service of science teaching at grades two and three studying at Alanya Alaaddin Keykubat University. The quantitative data for the study was obtained through "Verbal and Visual Dominant Learning Style Scale" developed by Akgün et al. (2014) while the qualitative data was gathered from the participants' sketchnotes prepared for various science topics in the secondary school science curriculum. The findings indicate that the majority of the participants had visual dominant learning style. As the participants with visual dominant learning style gave prominence to visuals by using drawings and various writing styles frequently in their sketchnotes, the ones with verbal dominant learning styles used more words and sentences along with frequent textual detailed explanations. It was also found that the participants with visual dominant learning style placed more importance to process building, grouping, and listing and the ones with verbal dominant learning styles placed more emphasize on explanations. The findings of the study are meant to introduce sketchnotes to teachers and to promote the use of them in their teaching practices.

Key words: Learning style, visual and verbal learning, science teaching materials, sketchnotes, pre-service science teacher.

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Introduction

The introduction of Cognitive Learning Theory led researchers to place specific attention to learner characteristics during learning processes. They have investigated how learners choose the way to learn, how learner characteristics influence these choices (Morgan, 1997), and tried

to explain the processes that learners go through during learning. Researchers have also attempted to identify learning styles by categorizing learners' characteristics as cognitive and emotional (Kolb, 1981), biological (Dunn & Dunn, 1993), and social (Grasha, 1996). For Kolb (1981), learning styles are the methods individually chosen to perceive and process information. A similar definition by Dunn (1984) states that each individual determines the way to understand and saves information, which is usually conducted in a unique way. According to Fleming (2001), learning style is also an individual's characteristics and preferred ways of gathering, organizing, and thinking about information. Grasha (1996) explains the concept based on social learning theory and claims that learning styles are predispositions that affect learners' receiving information, their interactions with teachers and peers, and their participation skills to learning experiences.

Acknowledging the significance of learning styles, researchers have explored individual learning types and preferences. Gardner (2011), for instance, has classified types of individual learning and intelligence in his "Multiple Intelligences Theory". He has demonstrated nine types of intelligence including verbal/linguistic, visual/spatial, and bodily/kinesthetic as well as logical/mathematical, musical, interpersonal, intrapersonal, naturalistic and existential intelligences (Gardner, 2011). Unfortunately, the evidence reported in educational research indicates that the present programs of schools is mostly based on verbal/linguistic intelligence, leaving out the other types. Providing learners with information utilizing both visual and audio modes, as suggested by the "sensory-channels" model of presenting information, is usually assumed to be achieved by just using the board to present linguistic input. However, as the physicist John Howarth describes, using imagery and picture language (visual/spatial intelligence) assists learners through problem-solving processes and enhances achievement:

> *I make abstract pictures. I just realized that the process of abstraction in the pictures in my head is similar to the abstraction you engage in dealing with physical problems analytically. You reduce the number of variables, simplify and consider what you hope is the essential part of the situation you are dealing with; then you apply your analytical techniques. In making a visual picture it is possible to choose one which contains representations of only the essential elements—a simplified picture, abstracted from a number of other pictures and containing their common elements.(John-Steiner, 1987, cited in Armstrong, 2009).*

Visual learning is defined as the construction and acquisition of information through interactions with visual elements (Seels, 1994). Visual materials are crucial in visual learning. As teaching materials, pictures, graphs, tables, or drawings can facilitate learning as they enable learners to visualize abstract concepts and internalize them more easily. Visuals also help learners to understand relationships between concepts while increasing their attention and enriching the learning process. Visualization, colour cues, picture metaphors, idea sketching, and graphic symbols are among the teaching strategies and materials that could be used in visual learning. Verbal learning is, to an extent, the construction of information via verbal and written forms. Speaking, reading or writing activities are important for verbal learning, which are dominant learning procedures commonly practiced in traditional classroom activities such as listening to teachers' lectures, reading from text books, or writing down the information on the board. Yet, activities like storytelling, discussion, brainstorming, word games, journal writing, or publishing could also be used to support verbal learning (Armstrong, 2009).

Materials used in visual and verbal learning processes help comprehension, increase retention, and enrich learners' learning experiences. The interaction between learners and learning materials occurs though the language of visual designs in the materials. Both words (e.g., in sentences, paragraphs or headings) and the images (e.g., such as pictures, designs and photos included to add simple or abstract meanings) form the information communicated in visual materials. Whatever elements are used in these materials, all compose the learning elements in harmony (Alpan, 2008) and help learners, particularly the ones with visual/verbal learning styles. Sketchnotes are among the materials that could be used for learners with visual/verbal dominant learning styles.

Sketchnotes

A sketch is defined as 'a quick rough drawing or outline by hand in simple strokes (Kurz, 2008 cited in Fernandez-Fontecha et al., 2018). Sketches can increase learners' abilities of thinking, transferring, and of their formation of knowledge. The relationship between the individual and the sketch is in fact the interaction of the mind, the eye, the hands, and the image and involves the acts of questioning and resolving. These acts are based on the stages of analysis, synthesis, and evaluation (Yakın, 2015). Sketching enables learners to depict and communicate abstract ideas; to illustrate processes of structures of complex systems; and to clarify and to externalize complex chunks of information. Sketchnotes also reflect learners' cognition as learners need to use visual, spatial, and conceptual knowledge and skills when

preparing and communicating with sketches; and therefore, they provide opportunities for understanding human cognition more generally (Forbus, et al., 2011).

Sketchnotes, or visual note-taking, are visual stories created while reading a text, organizing an event, or listening to a talk. While they could be easily created by using just pen and paper, sketchnotes, engage learners in a productive information accumulation process that can lead to further knowledge production (Li et al., 2002). They can consist of a mixture of text and visuals such as handwriting, drawings, hand-drawn typography, shapes, pictures, arrows, boxes & lines, objects, frames, letters, or numbers (Rohde, 2013). An example of sketchnote is presented in Figure 1.

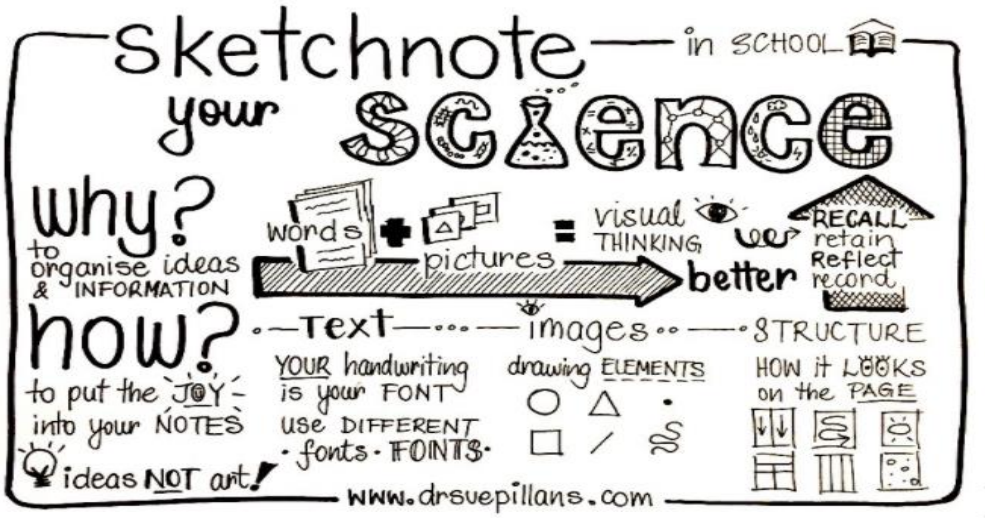

Figure 1. Example of a sketchnote (Panao, 2021)

Recently, sketchnoting has been gaining popularity at scientific and technical events such as conferences and workshops, where the content of an event is captured visually, later edited and shared via social networks and blogs. They are also increasingly being used in science teaching as they are effective tools to simplify complex scientific explanations and to introduce conceptual thinking in problem solving processes (Fernandez-Fontecha et al., 2018). Bratash, Riekhakaynen, and Petrova (2020) imply that the sketchnoting technique is useful for developing such cognitive skills as abstract reasoning, imagination, artistic vision of the world. Furthermore, sketchnotes have quite high informative value and help to memorize and recall the information. The sketches are used by students to share their ideas with one another. Thus, making sketches involves students in epistemic practices of science including representing observations and ideas, as well as comparing and communicating ideas (Enfield, Smith, & Grueber, 2008).

By using sketchnotes, chunks of information could be listed, grouped, or associated in written or visual formats. They can be used to take notes of the learning materials, summarize, brainstorm, interact or to prepare a plan for any learning task. They can also enable learners to supplement their handwritten text by reinforcing major concepts with images and help them to organize their thoughts without requiring learners to be talented in drawing or painting. Sketchnotes can help learners to improve their creativity as they can be used freely and creatively for any subject. They help to visualize the learning material and thus, to make learning easier and more retentive. By making lessons more enjoyable, sketchnotes can also increase learner participation and concentration as well as encouraging creative thinking (Enfield, Smith, & Grueber, 2008; Robinson, 2018; Fernandez-Fontecha et al., 2018).

Aims of the study

As sketchnotes include both visual and verbal elements, they can attract the attention of learners with different learning styles and could be used as educational tools for different teaching purposes such as to take notes, plan, summarize or to evaluate. Thus, determining how sketchnotes are affected by learners' verbal or visual learning styles could enable better planning for lesson materials, assignment tasks, or other instructional activities. The related literature includes studies that focus on preparing sketchnotes (Rohde, 2013), reasons of their use (Altieri, 2017; Robinson 2018; Fernandez-Fontecha et al., 2018) and their application in science education (Enfield, Smith, & Grueber, 2008; Forbus, et al., 2011; Bratash, Riekhakaynen, & Petrova, 2020). It could also be observed that there have been studies conducted on the use of sketchnotes in the last 10 years and this line of research has been gaining popularity among researchers in recent years. However, no research conducted to investigate the use and the impacts of sketchnotes or how they are prepared by learners with different learning styles could be found in Turkish context. Therefore, the present study could provide an alternative approach to educators. In this respect, the study aims to investigate the effect of the participant pre-service teachers' dominant visual and verbal learning styles on their designs of sketchnotes prepared for science topics while determining the reasons for including visual and written elements in these sketchnotes. In this respect, the participant pre-service teachers' dominant learning styles were determined and the effects of these learning styles on the elements used in their sketchnotes were analysed. The visual and written elements in the sketchnotes were also analysed in terms of their intended purpose. With these aims in mind, the following research questions are sought:

1) What are the dominant learning styles of the participant pre-service teachers?

2) Which visual and written elements do the participants use?

3) What are the participants' reasons for including visual and written elements in their sketchnotes?

4) Are there statistically significant differences between the pre-service teachers' dominant learning styles and their use of visual elements in their sketchnotes?

5) Are there statistically significant differences between the pre-service teachers' dominant learning styles and their use of written elements in their sketchnotes?

Method

The study was designed following descriptive correlational survey model as it aims to explore the effect of pre-service teachers' dominant learning styles on their sketchnotes designs on science topics. While descriptive research refers to investigation of an event or a phenomenon in its existent state, correlational studies are used in order to explore relationships between two or more phenomena (Karasar, 2002).

Participants

The sample of the study was formed following convenience sampling method. The participants consisted of the pre-service teachers who were registered in one of the courses of the researcher and who volunteered to participate in the study. In total, 44 higher education learners studying at Faculty of Education at Alanya Alaaddin Keykubat University. They were at the second grade (n=24) and at the third grade (n=20) of science teaching department. While the majority of the participants were female (n=30), the males constituted a smaller group (n=14). They had previously taken courses on science learning and teaching approaches and teaching materials as well as physics, chemistry, and biology.

Data tools

The data was collected using a Likert-type questionnaire and sketchnotes. In order to identify the participants' visual or verbal dominant learning styles, "Style of Processing Scale" developed by Childers, Houston and Heckler (1985) was used. The scale consists of 22 total items under two dimensions, visual learning style and verbal learning style, with 11 items each. Designed as a Likert Scale, the items are anchored in 4 (Always True For Me), 3 (Usually True For Me), 2 (Usually Not True For Me), and 1 (Never True For Me). Scoring low on the scale would indicate that the participant has verbal dominant learning style while high scores would imply having visual dominant learning style. The internal consistency of the subscales were

calculated using Cronbach Alpha, and it was found that the sub-scales have high internal consistency values (α= .81 for verbal learning style dimension and α= .86 for visual learning style dimension). The scale has been adapted to Turkish by Akgün, Küçük, Çukurbaşı and Tonbuloğlu (2014) and published as "Sözel veya Görsel Baskın Öğrenme Stilini Belirleme Ölçeği [Verbal and Visual Dominant Learning Style Scale]". The adapted version of the scale has two dimensions (verbal learning style and visual learning style) with eight items for each and 16 items in total. Cronbach Alpha value of the adapted Turkish Scale is calculated as α= .69 for verbal learning style dimension and α= .71 for visual learning style dimension.

The participants were also requested to prepare a sketchnote for a topic they would choose among secondary school science topics by using visual and written elements. The participants were asked to prepare sketchnotes for different grades (from 5^{th} to 8^{th}) on one of the science topics (e.g., Cells and Divisions, DNA and Genetic Codes, Matter and Heat, Matter and Industry, Basic Machinery, Electric Charges, Photosynthesis, etc.). They were informed about preparing sketchnotes and possible materials they could use along with some sample sketchnotes. Then, they were allocated a week to prepare their sketchnotes. Previous to these implementations, an ethical approval was obtained from Science and Engineering Scientific Research and Publications Ethics Committee of Alanya Alaaddin Keykubat University (12.03.2021/9705).

Data analysis

The responses of the participants to the questionnaire were analysed statistically using SPSS 22.0 program. The participants who scored high in visual dimension were grouped in visual dominant learning style, the ones who scored high in verbal dimension were grouped in verbal dominant learning style, and finally the participants who scored equally in both dimensions were included in visual-verbal learning style group. Since the data was not normally distributed, non-parametric analyses were conducted.

For the sketchnotes, content analyses were conducted by the researchers. First, the visual and written elements in their sketchnotes were analysed by each researcher separately and the relevant codes and the themes were formed. The agreement level between the two researchers' results was calculated using Miles and Hubermann's (1994) formula and was found to be 82%. Then, the researchers discussed the codes and the themes determined separately and prepared a checklist based on the agreed codes and themes. Then, two experts, a science teacher and an academician in science teaching, were asked to analyse the checklist and give feedback. Each was given five different sketchnotes to analyse using the checklist. Based on their feedback, the

checklist was modified by the researchers and finalized before it was used in the analyses of the present (Table 1). The scores obtained from the checklist for the sketchnotes and the scores from the learning styles questionnaire were analyzed statistically.

Table 1. The checklist used to analyse sketchnotes

Visual Elements	Examples	Written Elements	Examples	Reasons for Use	Visual-Written Elements
Drawings	Objects, symbols, models, etc.	Words		Organizing	Tables, diagrams, charts, shapes, sub-headings
Shapes	Square, triangle, rectangle, star, line, etc.	Sentences		Establishing Relations	Arrows, shapes
Arrows	→,↑,↓,↔, etc.	Heading		Creating Process	Arrows, shapes, bullets
Punctuation Marks	Quotation mark, exclamation mark, question mark, parentheses, brackets, etc.	Sub-heading		Emphasizing	Drawing, shapes, font styles, arrows, punctuation marks
Mathematical Symbols	+, -, x, =, >,< ,∞, etc.	Written Symbol	Symbols, formulas, equation	Grouping	Arrows, shapes, bullets
Bullets	√, >, *, •, letters, numbers, etc.			Listing	Bullets, math symbols, arrows
Font Style	Bold-thin, italic, upper-lower case, underlined, font shadow, coloured, etc.	Frames	Speech balloons, information boxes	Modeling	Drawing, words, sentences
Tables	Single variable, bivariate, etc.			Explaining	Words, sentences, heading, sub-heading, written symbol, drawing, frames, math symbols
Charts	Bar, line, pie, etc.			Exemplifying	Drawing, frame, words, written symbol
Diagrams	Venn diagram, flow, organization chart, etc.				

The visual and written elements in the sketchnotes and their purpose of use were analysed using the checklist prepared for the research. Visual elements include the visuals such as drawings, arrows, shapes, marks, font styles, tables, charts, or diagrams used to explain the

topic. Written elements, on the other hand, comprises words, sentences, headings, sub-headings, frames, or written symbols included for explanation. The reasons for using of these elements may vary. For example, arrows could be used to signal a process or to show relationships. Similarly, in order to emphasize a concept, an exclamation mark could be added or the word could be underlined or coloured. Figure 2 illustrates a sketchnote prepared by one of the participant pre-service teachers. The analysis of the sketchnotes could be explained through the following example.

Figure 2. A sketchnote prepared by a participant learner

The sketchnote shown in Figure 2 was prepared to explain the concepts of temperature and heat. The main concepts (Heat and Temperature) are written in capital coloured letters and framed at the top of the sketchnote that includes various visual and written elements. The concepts are also explained under two headings using written elements such as single words or sentences along with visual elements of symbols (for energy) and objects (e.g., calorimeter pot, thermometer). Written and visual elements are associated by arrows while warning information is displayed within a frame (information box) and coloured. In order to show accurate and wrong daily use of the concepts, bullets are used (x, √) for the headings and the two groups are divided by a line while each example is presented by another bullet point (•), short sentences, or written symbols (°C) to add extra explanation. In the sketchnote, modeling [model (snow flake, sun), object (house) and symbol] is done by using different coloured font styles (e.g., underlined, capital cases, or colours).

Findings

The dominant learning styles of the participants are displayed in Table 2. Considering the dominant learning styles of the participants, the results indicate that 34 of them (77.2%) had visual, 7 (16%) had verbal, and 3 (6.8%) of them, scoring equally in the sub-dimensions of the scale, had visual/verbal dominant styles.

Table 2.Dominant learning style of the participants

Learning style	N	%
Visual learners	34	77.2
Verbal learners	7	16
Visual-Verbal learners	3	6.8
Total	44	100

The visual elements used in the sketchnotes of the participant learners based on their dominant learning styles are displayed in Table 3.

Table 3.The distribution of visual elements in sketchnotes based on dominant learning style

Visual elements	Visual learners		Verbal learners		Visual-verbal learners		Total	
	n	%	N	%	n	%	N	%
Drawings	34	100	7	100	3	100	44	100
Shapes	29	85,2	5	71,4	2	66,6	36	81,8
Arrows	29	85,2	3	42,8	2	66,6	34	77,2
Punctuation Marks	24	70,5	4	57,1	2	66,6	30	68,1
Mathematical Symbols	30	88,2	4	57,1	2	66,6	28	63,6
Bullets	34	100	7	100	3	100	44	100
Font Styles	34	100	7	100	3	100	44	100
Tables	25	73,5	-	-	2	66,6	27	61,3
Charts	27	79,4	-	-	2	66,6	29	65,9
Diagrams	27	79,4	4	57,1	2	66,6	33	75

It can be seen that all the participants paid attention to using drawings, bullets, and font styles in their sketchnotes. Tables, on the other hand, were the least frequently used visual elements. The participants with dominant visual learning style were found to include more shapes, arrows,

tables, charts, and diagrams in their sketchnotes compared to the participants with verbal dominant and verbal/visual dominant learning styles. Another significant finding is that the participants with verbal dominant learning style did not use tables or charts. The distribution of the written elements in the participants' sketchnotes based on their dominant learning styles are presented in Table 4.

Table 4.The distribution of written elements in sketchnotes based on dominant learning style

Written elements	Visual learners		Verbal learners		Visual-verbal learners		Total	
	n	%	N	%	N	%	N	%
Words	23	67,6	7	100	1	33,3	31	70,4
Sentences	34	100	7	100	3	100	44	100
Headings	34	100	7	100	3	100	44	100
Sub-headings	21	61,7	6	85,7	1	33,3	28	63,6
Frames	20	58,8	6	85,7	2	66,6	28	63,6
Written Symbols	20	58,8	6	85,7	3	100	29	65,9

The results show that all of the participant learners included headings and sentences (short explanations) in their sketchnotes. However, verbal learners added further explanations by using sub-headings while employing single concept (word) use (e.g. Golgi-packet, mitochondria-energy, etc.) for emphasizing or modeling. Similarly, these learners were found to use speech balloons and information boxes more frequently. The visual/verbal learners, on the other hand, all used written symbols in their sketchnotes. Table 5 displays the reasons for using written and visual elements in the sketchnotes.

Table 5.The reasons for using written and visual elements in the sketchnotes

Reasons for Using Elements	Visual learners		Verbal learners		Visual-verbal learners		Total	
	n	%	n	%	n	%	N	%
Organizing	30	88,2	4	14,2	3	100	37	84,1
Establishing Relations	27	79,4	3	42,8	1	33,3	31	70,4
Creating Flows	15	44,1	1	14,2	-	-	16	36,3
Emphasizing	34	100	7	100	3	100	44	100
Grouping	22	64,7	4	14,2	1	33,3	27	61,3

Listing	34	100	5	71,4	3	100	42	95,4
Modelling	20	58,8	2	28,5	2	66,6	24	54,5
Explaining	34	100	7	100	3	100	44	100
Exemplifying	22	64,7	5	71,4	1	33,3	28	63,6

When analysing the participants' reasons for using written and verbal elements, it is found that all of the learners used both elements to explain and to highlight the important points. Also, all of the participants preferred listing in order to explain the content itemized in bullets. The findings also show that words, sentences, and drawings were used most frequently for explanations; font styles and colours for emphasis; while bullets and arrows were mostly preferred for listing. The analyses of the sketchnotes prepared by the visual-verbal learners indicate that all of these learners paid particular attention to organization by either using tables, charts, and diagrams to explain the content or by drawing lines to divide the page into multiple sections. This group was also found to use modeling most frequently by utilizing words and drawings (e.g. for DNA, atom, circuit model, etc.). Creating flows of processes were used most frequently by the visual learners. They explained topics such as substance cycle, seasons, or food chain using circular processes. This group also preferred to explain information by using arrows to match concepts or to relate written and visual elements more frequently than the other two groups while choosing to use words and drawings for exemplification. The differences between the participants' dominant learning styles and the frequency of their using visual elements in their sketchnotes are displayed in Table 6.

Table 6.The differences in the scores received from the visual elements in the sketchnotes based on dominant learning styles

Learning Style	N	Mean Rank	df	x^2	p
Visual learners	34	26,35	2	14,376	,00
Verbal learners	7	8,14			
Visual-Verbal learners	3	12,33			

The visual elements used in the participants' sketchnotes were analysed based on their dominant learning styles. According to the results from Kruskal Wallis H-test independent samples test, there is a significant difference in the use of visual elements based on the participants learning styles ($x^2(2)=14,376$, $p<.05$). The reason for the difference was analysed using Mann Whitney U-Test for independent samples. The results show that there is a

significant difference in terms of visual element use between the participants with visual learning style and the ones with verbal style (U=23,00, p<.05). The visual learners are found to use visual elements significantly more frequently than the visual-verbal learners (U=16,00 p<.05). However, there is no significant difference in the use of visual elements between the participants with visual-verbal learning style and verbal learners (U=6,00 p>.05). The differences in the scores of the participants' received from the written elements in the sketchnotes based on their dominant learning styles are presented in Table 7.

Table 7.The differences in the scores received from the written elements in the sketchnotes based on dominant learning styles

Learning Style	n	Mean Rank	df	x^2	p
Visual learners	34	20,50	2	7,482	,02
Verbal learners	7	34,07			
Visual-Verbal learners	3	18,17			

The written elements in the participants' sketchnotes were analysed using Kruskal Wallis H-Test independent samples test. There is a significant difference in the use of written elements based on learning styles ($x^2(2)=20,50$, p<.05). The reason for the difference between the groups were investigated using Mann Whitney U-Test for independent samples. Accordingly, a significant difference was found in terms of written element use between the participants with verbal learning style and the ones with visual style (U=47,00, p<.05). It is revealed that verbal learners use written elements significantly more frequently than visual-verbal learners (U=1,50, p<.05). On the other hand, the visual learners are found to be using written elements at similar levels as the visual-verbal learners (U=47,00, p>.05).

Results and Discussion

Learners use their learning styles actively while accessing, understanding and processing information. While some learners respond better to diagrams, charts and pictures; others learn better with verbal or written explanations. The majority of the participant learners in the study were determined to have visual dominant learning style (77.2 %). A similar result was found in the results of the study conducted by Günes, Bati and Katrancı (2017). When the participant learners' distribution based on their learning styles were analysed, it was found that 65 % of them were, 8 % were verbal, and 27 % of them had balanced distribution. However, considering the common fact that the majority of the classroom instruction is carried out verbally, it can be argued that many learners cannot benefit from the lessons instructed verbally. Those who learn

effectively are the ones that can process information both visually and verbally (Felder, 1993). In learning situations where knowledge is transferred both verbally and visually, all learners learn more effectively. Furthermore, Iuera, Neacşu, Safta, and Suditu (2011) claim that there is a significant relationship between learning styles and teaching styles. Accordingly, when teachers use instructional approaches and tools based on their learning styles could lead to difficulties for both learners and teachers with different learning styles. As it is important to have a concordance between the teacher's and the learners' learning styles, teachers need to exhibit instructional practices considering those with different styles while learners are advised to accommodate to activities and tasks based on different styles. In fact, Hayes and Allison (1997) point out that when learners are involved in learning activities that do not match their preferred learning style, they are likely to develop learning competences necessary to cope with a wide range of learning requirements. At this point, sketchnotes could assist learners to develop such skills. Using visual and verbal elements in their sketchnotes, learners can acquire various learning styles and skills through utilizing sketchnotes for learning processes such as providing explanations, planning, or making learning decisions.

Another significant finding of the study is that the learners' dominant learning style is influential in their use of visual and written elements in the sketchnotes. The learners with visual learning styles used more visual elements in the sketchnotes they prepared while verbal learners used written elements more. Explaining learning based on sensory-model, Fleming states that visual learners prefer maps, charts, graphs, diagrams, brochures, flowcharts, highlighters, different fonts and colours, pictures, word pictures, and different spatial arrangements. On the other hand, verbal learners like to explain new ideas to others, discuss topics with other students and their teachers, use a tape recorder, attend lectures and discussion groups, and use stories and jokes. Read/Write learners prefer lists, essays, reports, textbooks, definitions, printed handouts, readings, manuals, Web pages, written explanations, and taking notes (Fleming, 2001). The visual learners in the study were found to use visual elements such as shapes, charts, tables, diagrams frequently while integrating drawings, different font styles and colours were dominant in organizing and designing their pages. Conversely, verbal learners mostly used speech balloons, information boxes, sentences, and words for the definitions and explanations in their sketchnotes. It was also evident that verbal learners used headings and sub-headings to organize their sketchnotes. On the other hand, the participant pre-service teachers with both learning styles used visual and written elements together. The learners in this group used drawings, charts, tables, diagrams in addition to written elements to explain their topic

(Pritchard, 2009). It should also be noted that visual-verbal learners are advantageous in that they can utilize visual elements more frequently than verbal learners do while integrating more written elements than visual learners do. As Enfield, Smith and Grueber (2008) indicate, sketches are visuals used as communication tools like sentences. Sketches prepared using various elements can be used to provide extensive explanations or to represent ideas. The use of multiple elements can also help to communicate the explanations or comparisons of various scientific ideas.

Another significant finding of the study is the reasons for using visual and written elements in the sketchnotes. Analysing the elements in the sketchnotes based on the participants' dominant learning styles, it was found that they used these elements to explain, list, or to highlight concepts. In addition, visual learners mostly explained concepts by forming associations whereas verbal learners preferred exemplifying. Modeling was most frequently used by visual-verbal learners. Similarly, Altieri (2017) maintains that learners use colours, words, symbols, or drawings in their sketchnotes to show meaning and relationships between ideas, and that sketchnotes are effective in sharing and discussing ideas. Bratash et al. (2020) highlight that unusual letters and portraits are important pieces of information that are found interesting and useful by learners as they enable them to summarize, memorize, and/or retain information. Robinson (2018) also highlights that sketchnotes assist learners in organizing ideas and in improving their creativity.

Implications

The present study sheds light on how learners organize information in their minds and how they are able to associate and explain their ideas or concepts. Based on the findings of the study, the following suggestions could be proposed:

1) In the study, visual and written elements in the pre-service teachers' sketchnotes prepared for a science topic were analysed based on their dominant learning styles. Further studies can focus on the sketchnotes prepared for teaching or for evaluation of the taught concepts. Sketchnotes could be used to explore learners' conceptual change or to identify their misconceptions.

2) Sketchnotes can be used to explore cognitive and meta-cognitive strategies used by learners to plan, monitor, and to evaluate their learning processes. Sketchnotes could also be used to improve learners' use of meta-cognitive strategies.

3) In addition to preparing sketchnotes by using papers and pencils, there are software programs that allow learners to create sketchnotes in computer environment. Using such educational software programs, learners can prepare sketchnotes in a short time by integrating numerous visual and written elements and share them online.

4) Introducing sketchnotes to in-service and pre-service teachers could help disseminating and broader use in teaching and learning processes. They enable teachers easily plan and enrich their teaching.

5) Use of sketchnotes in other courses could assist learners. They help learners by providing more entertaining and more fruitful learning experiences suitable to their learning styles.

Notes

Ethical approval for this study was obtained from Science and Engineering Scientific Research and Publications Ethics Committee of Alanya Alaaddin Keykubat University (12.03.2021 / 9705).

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