Enver Aydın Kolukisa[1]
Elif Aladağ[2]

THE USE OF AERIAL PHOTOGRAPHS IN GEOGRAPHY EDUCATION

Introduction

As the teachers of geography, we are able to draw upon a very rich variety of resources. The resources that we use and the ways we use them help us to bring what we teach alive. They have also an important influence on pupils' interest and motivation to learn. The quality and suitability of the resources that we select and the ways they are used by pupils are the critical factors influencing whether the learning is succesful or not (Lambert & Balderstone, 2001). There are rich variety of resources geography teachers can use at their lessons. Aerial photography is one of the effective resources for teaching geography.

What is aerial photograph?

Aerial photograph is a term used for photographs taken from a plane. Maps are prepared using aerial photographs, and they also provide help in gaining knowledge about the field such as its use, surface structure, vegetation and cultural evidence. Due to these qualities aerial photographs are used in fields like erosion control, hydrographs, forestry, archaeology, geology, planners etc. In physical and human geography, aerial photographs are also used as tools (Bilgin, 1983).

Aerial photography is almost as old as photography itself**.** The first use of camera to record the view from above occured in 1858 when Nadar, a loft in a balloon, took a photograph of French chateau below him. Realizing the value and uniqueness of the view, he produced a series of photographs of Paris, which he sold to the public. Over the years a number of various methods have been employed to capture the eagle's view (Eller, 2000).

Until recently, the majority of aerial photographs were taken for the information they could provide. Engineering, construction, mapping and surveying all rely heavily upon the camera's ability to provide an impartial representation of the earth. This is known as photogrammetry, with the addition of rocket and satellite imagery, has become the science remote sensing (Eller, 2000).

[1] Enver Aydın Kolukisa, Assoc. Prof. Dr., Gazi University, Gazi Faculty of Education Ankara, Turkey.
[2] Elif Aladağ, Res. Assist., Gazi University, Gazi Faculty of Education Ankara, Turkey.

There are three basic compositions which are used for aerial photographs (Eller, 2000; Bilgin, 1983):

a) *Vertical Aerial Photographs:* Taken from an angle of pointed straight down and with all four corners equidistant from the film plane, producing a map-like perspective. A vertical format has the advantage of providing a readable scale to the photograph. It covers relatively small area.

b) *High Oblique Aerial Photographs:* Taken from an angle of approximately 70 degrees off the vertical axis. These photographs include the horizon and the sky. It covers a very large area. This is the view most people associate with looking out of an airplane window.

c) *Low Oblique Aerial Photographs:* Taken from an angle of approximately 40 degrees off the vertical axis. In comparison to high oblique, corruption is less in low oblique. When a wider area needs to be covered this type of photographs are taken. High oblique photographs can be taken from lower altitudes.

Geography Education and Aerial Photographs

Aerial photographs are effective tools for geography education. It is possible for students to find aerial photographs of the local areas and those others anywhere in the world related to the subject they study. They provide an incredible amount of detail—some at 1 meter or even at 1 foot resolution – for students to examine everything from the land use patterns in their own community for urbanization, afforestation, deforestation, river deltaic processes, glacial retreat, and other processes around the country and around the world (Kerski, 2006).

Students should be helped to understand the important elemets of aerial photographs if they will be able to use these resources effectively. The effect of perspective will influence the shape and spatial arrangement of features veiwed in a photograph. The scale is calculated as the ratio of the focal lenght of the lens to the altitude of the aircraft. For example, a 5 cm (2 inch) lens on a camera photographing from an altitude of 500m would be expressed as a scale of 5/50000 or 1/10000. The effect of scale means that, as the scale of a photograph becomes smaller it becomes more difficult to identify the details of features. Whereas the scale of a map is consistent over the whole map, the scale of the photograph varies with distance from the camera. Students often overestimate the size of areas shown on a photograph when they are comparing it with a map, so it is useful to get them to measure the distances across the various components of the area shown on the photograph using the scale on the map (Lambert & Balderstone, 2001).

For pupils who are unfamiliar with aerial photographs, a useful strategy to illustrate the effect of perspective is to start with ordinary ground level photographs before moving on to investigate the different perspectives shown in

oblique and vertical aerial photographs. Although aerial photographs have some similarities with regular photos, they are some differences:(1) objects are portrayed from an overhead position most people are unaccustomed to seeing. In fact we cannot see the world totally vertically even from a plane. So it is possible for students to see from a different angle. When observed from very high points mountains and hills are seen flat, while rivers are exactly like the map. Very often, infrared wavelengths are recorded; (2) Photos are taken at scales. This helps to cover a wider surface area, which than helps students to see the area they study as a whole.

Once pupils comprehend these elements of aerial photographs, they should be given a variety of opportunities to practise and to develop their skills in interpreting these photographs progressively. Figure 1 attempts to summarize a possible approach to the progressive development of these skills.

Stage One: Familarity with aerial photograph • Understand the effect of "perspective" and "scale". • Differences between ground-level, oblique and vertical views.
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Stage Two: Recognation and identification • Identifying specific features starting with familiar local features or those with shapes that are easy to recognize. • Human features such as types of building and housing, transport routes and other land use. • Physical features such as large coastal landforms, valleys, mountain ranges and drainage patterns.
↓
Stage Three: Interpretation • Identifying less obvious features. • Describing patterns and simple relationships. • Using evidence from the images to investigate patterns and relationships between places.
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Stage Four: Advanced Interpretation • Using evidence from the images to suggest reasons for patterns and relationships. • Using this evidence with information from other sources, selecting and using appropriate skills in geographical inquiries.

Figure 1. – Progression in the development of skills used to interpret aerial photographs (Lambert & Balderstone, 2001)

Aerial Photographs And Maps

There is an important link between maps and the use of aerial photographs. Both type of material can help pupils to develop the concepts of loca-

tion, direction, plan view and distance (Foley&Janikoun,1996). Although maps and aerial photos have some similarities, aerial photographs are not maps. The principal difference is that they show everything from above, not just these phenomena which the cartographers select to the map. This includes emphemeral and transitory features such as traffic, snow and smoke. Neither the photographs have conventional symbols nor boundaries nor placename labels. There are other, more subtle differences, too. Consider an aerial photograph taken with the camera pointing directly downwards the Earth. The only truly overhead part of the photograph is in the centre; the other edges present a view at least to some extent from the side. This means that even with a vertical aerial photograph you can see the sides of buildings the further you look from the centre of the photograph. A map, on the other hand, always shows a view directly from above, no matter where on the map you look (Wiegand, 1993).

Plester et al. (2003), compared children's map use and photograph use. In that experiment the children were better at using a photograph, and if they saw a photograph before using a map, this improved their later performance with a map. This pattern of result supports the suggestion that young children would benefit from working with aerial photographs before they start working with maps.

Because using aerial photographs requires some of the skills involved in map using, Rifle (1969) and Muir (1969) suggested that mapwork can be successfully introduced via aerial photographs (Wiegand, 1993). A topographic map may be obsolete because it was compiled many years ago. A recent aerial photograph shows any changes that have taken place since the map was made. It provides a current pictorial view of the ground that no map can equal. For this reason, maps and aerial photographs complement each other. It provides a permanent and objective record of the day-to-day changes with the area. More information can be gained by using the two together than by using either alone.

Understanding of Aerial Photographs Through The School Years

Aerial photographs have long been an important resource for geography education. But it is claimed that recognizing features on photographs involves being able to undertake fairly complex mental operations such as adopting a view from above, reducing one's three-dimensional view of the world to a two-dimensional one, mentally reducing the scale of the environment and then abstracting it into semi-iconic symbols (Wiegand, 1993). Aerial photographs are used with the assumption that children can understand such photographs from about seven or eight years of age. The assumption grows out of the classic view of Piaget and Inhelder (1956) that children from this age will be reliable in making the mental transformations of scale and perspective that are necessary for understanding an

aerial photograph (Plester et al., 2003). There are many studies about the use of aerial photographs in early stages of geography education for young learners.

Many studies (Spencer, 1980; Walker, 1980; Mc Gee, 1982; Matthews, 1985; Blades ve Spencer, 1986; Bluestein ve Acredolo, 1979) have demonstrated that children have substantial mapping abilities at ages before that of school entrance (Blaut, 1997).

Stea and Blaut (1997), have shown that 5-6 year old children can read black and white vertical aerial photographs. However, they also put forward some criterions for the aerial photographs that can be used with this age group:

- The scale of the aerial photograph must be large so that a child would be able to recognize individual landscape features known previously from a ground view: scales on the order of 1:2,000 to 1:7,000.
- They suggested the use of aerial photographs of familiar areas, if this can be obtained, such as school, neighbourhood etc.

Plester et al. (2002), showed black-white vertical and oblique aerial photographs to 4-5 year old students. Children gave mostly correct answers to the questions about free response identification of features, location of photographer, identification of the represented space, location of features in the environment and self location on the photograph. The results of the experiment showed that preschoolers can use an aerial photograph as a map in complex real world contexts. Previous researchers only asked children to describe what they could see in the photograph. In this study children not only had to interpret what they could see but they were also asked to relate the photograph to the environment. In this way they demostrated that young children can appreciate an aerial photograph as a representation of real place. This research also supported previous researchers (Blades et al., (1997); Liben & Yekel (1996) who have also found that children understand oblique aerial photographs better than vertical aerial photographs. So it is suggested to use oblique aerial photographs at preschool students' teaching.

Blades et al. (1998), investigated the mapping abilities of four-year-old children in England, South Africa, Iran, Mexico, USA. They used a methodology involving air-photo identification and simulated navigation on an air photo. The results show that essential mapping abilities (perspective and scale transformations) are well developed by the age of four in these cultures. The crucial finding is that four-year-olds in all five cultures demonstrated an ability to interpret a map-like model, an aerial photograph, in the sense of being able to perceive that a downwardlooking, scale-reduced image of a landscape is a representation of a landscape.

Some researchers (Mc Cleary & Blaut, 1970; Blaut & Stea, 1971; Spencer, Harrisson and Darvizeh, 1980) have claimed that children as young as three years have some understanding of aerial photographs as representations of real spaces (Plester, Richards, Blades & Spencer, 2002).

However, some researchers oppose to the opinion of preschool children to be able to understand and use aerial maps. Libens and Downs (1987, 1989, 1991, 1994), state that perspective and scale are important skills in understanding aerial photographs and that these skills are not developed in preschool children. They can be used with 2nd and 3rd grade students (Blaut, 1997 & Plester et al., 2002).

Muir (1970), Hart (1970) and Anderson (1985) have demonstrated that air photos can be used in the elementary-school curriculum (Blaut, 1997). In the UK national geography curriculum, aerial photographs are a recommended resource for seven- to eight-year-old children. According to this curriculum children have to be able to "identify familiar features on photographs and pictures (level 2) and "identify features on aerial photographs (level 3). For level 4, children have to be able to relate a map and aerial photograh of the same place by identifying features common to both. The sequence is clear therefore: identify familiar feartures first at ground level, then proceed to the view from overhead and then relate this to the maps (Wiegand, 1993).

Advantages and Disadventages of Using Aerial Photographs in Geography Education

Some advantages of aerial photographs in geography education are:

- Aerial photographs provide the oppurtunity for students to see the area from any part of the world from bird's eye view.
- An aerial view can show the relationship between the buildings and the landscape better than a ground level view.
- Using aerial photographs improve students' map using skill.
- Aerial photographs can open students eyes to the new perspectives and increase their awareness of the world around them.
- Aerial photographs are a the powerful tools for studying the earth's environment.
- Aerial photographs that were taken in the past are useful in historical geography or in teaching the changes that occured in a period of time, for example in showing how human and physical geography of an area can change.
- Historical aerial photographs are one of the most powerful tools for environmental monitoring. Analysis of aerial photographic data can be as simple as the creation of overlay maps spanning multiple eras or as complex as the computation of three-dimensional surface changes over time (Paine and Kiser, 2003:379).

Besides these benefits, aerial photographs have also limitations. For example, if there are companies that provide aerial photographs, they provide them expensively. However, if we think that once it is bought we can use it for a

long time, than we may be able to ignore the cost. In recent years aerial photographs with high resolutions, of many different areas are being published on the internet. Thus both teachers and students can benefit from them.

Another limitation is ground features which are difficult to identify or interpret without symbols in aerial photographs. Ground features are often obscured by other ground detail as, for example, buildings in wooded areas. Because of a lack of contrasting colors and tone, an aerial photograph is difficult to use in poor light.

Activities Using Aerial Photographs

Geography teachers and students can use aerial photographs in many ways and in many subjects. Here are some suggestions to encourage the use of aerial photographs in geography education.

Activity 1. Take photos around your school building and ground-side view, oblique view and plan. Have them mounted for young infants to talk about and identify. Recognizing familiar objects from unfamiliar angles-brick bonding, manhole covers, corners of buildings, the pond, seats – help develop the idea of oblique and plan view (Foley & Janikoun, 1996). Talking about the criteria in defining these objects has always been beneficial. These "basic elements" can aid in identifying objects on aerial photographs (Crum, 2000):

Tone (also called Hue or Color): Tone refers to the relative brightness or color of elements on a photograph. It is, perhaps, the most basic of the interpretive elements because without tonal differences none of the other elements could be discerned. For example woodland is usually dark green.

Size: The size of objects must be considered in the context of the scale of a photograph. The scale will help you to determine if an object is a stock pond or big lake. Factories are usually larger than houses.

Shape: Refers to the general outline of objects. Regular geometric shapes are usually indicators of human presence and use. Some objects can be identified almost solely on the basis of their shapes. Buildings are usually regular.

Texture: The impression of "smoothness" or "roughness" of image features is caused by the frequency of change of tone in photographs. It is produced by a set of features too small to identify individually. Grass, cement, and water generally appear "smooth", while a forest canopy may appear "rough".

Pattern (spatial arrangement): The patterns formed by objects in a photo can be diagnostic. Consider the difference between (1) the random pattern formed by an unmanaged area of trees and (2) the evenly spaced rows formed by an orchard.

Shadow: Shadows aid interpreters in determining the height of objects in aerial photographs. However, they also obscure objects lying within them.

Site: Refers to topographic or geographic location. This characteristic of photographs is especially important in identifying vegetation types and landforms.

Association: Some objects are always found in association with other objects. The context of an object can provide insight into what it is. For instance, a nuclear power plant is not (generally) going to be found in the midst of single-family housing.

Activity 2. Build up a collection of postcards. Some of them will often show oblique coastal views, oblique views taken from towers or high viewpoints. Children can discuss and identify geographical features freely or with your guided questions. Finally progress to vertical aerial photograph use. Figure 2 shows a range of activities which can be undertaken using vertical aerial photographs (Foley & Janikoun, 1996).

<table>
<tr><td>Use with familiar oblique or side view photos to link photo to location on aerial photo
Key Question: Can you locate roughly where this photo was taken?</td><td>Overlay it with alpha-numerical grid to locate features
Key Question:Where is our school?</td></tr>
<tr><td>Use aerial photograph to match up features
Key Question:Is this building really a school?</td><td>Practise compass directions
Key Question: Which way do you travel to get to the school?</td></tr>
<tr><td rowspan="2">Draw a map
Freehand (or soma scale) by using an overlay-select out certain information according to map purpose
Key Question: Can you show why the town grew up here?</td><td>Measure distance
Key Question: How far is it from our school to the library? Measure in “ruler” distance or use scale according to maths ability.</td></tr>
<tr><td>Plan a route
Key Question: How do we get from our school to the library</td></tr>
<tr><td>Identify changes on photo from personal experience
Key Question: This photo was taken in 1990. Was the market built then?</td><td rowspan="2">Map the land-use
Linear land use – road, rail Networks
Key question: Is this place easy to get to?
Spatial land use – housing areas, fields, woods
Key Question: Is there more settlement than green space in our environment?</td></tr>
<tr><td>Talk about features
Key Question:What is this?</td></tr>
</table>

Figure 2. – Using a vertical aerial photograph (Foley & Janikoun,1996)

Activity 3. Geography educators and their students can use the aerial photographs to analyze human and physical processes across the Earth’s surface, from across the country to right in your own neighborhood. Example questions include the following (Kerski,2003):

1) Land Use: What is the land use like in your neighborhood? In your region? How does it compare to land use elsewhere in your country? Why? What influence do population, climate, proximity to coastlines, and other phenomena have on land use? Why?

2) Landforms: What type of landforms exist in your neighborhood? In your region? How do they compare to landforms elsewhere in your country? Why? What influence do climate, geology, rivers, ancient and current processes, proximity to coastlines, and other phenomena have on landforms? Why and how? Examine the following landforms in your region and in other regions: plains, floodplains, alluvial fans, oxbow lakes, deltas, braided streams, intermittent streams, glaciers, glacial valleys, eskers, kames, moraines, coastlines, ancient lakes, cirques, buttes, mesas, lava flows, sand dunes, karst topography, rolling hills, mountains, valleys, swamps, marshes, lakes, and other landforms. How are these features evident on the topographic maps and aerial photographs? What will the landscape look like 10, 100, or 500 years from now?

3) Population: Can you estimate the population in the map or photograph of your neighborhood? In your region? How does it compare to population elsewhere in the United States? Why is it similar or different? What influence do land use, climate, perception, and other phenomena have on population? Why?

4) Urbanization: What type of dwellings do people live in around your area? How do these dwellings compare in size and density to those in other parts of your city? How do these dwellings compare to those in other urban areas? Why? What influences the size and density and type of dwellings?

5) Scale. How much terrain is visible (in square miles or square kilometers) at a resolution of 1, versus 2, 8, or 16 meters? How does the amount of detail change as the scale changes? What is the best scale to view a glacier? A school building? A river delta? A city? Why? How does the resolution of the aerial photographs compare to the topographic maps? What is the maximum that you can zoom in on an aerial photograph versus a topographic map?

6) Seasons: Examine some aerial photographs taken in summer versus winter, spring, and fall. What are the differences, in vegetation and sun angle, for example? Why do they exist? What would your area look like during the other seasons?

7) GIS uses: With a GIS, you can use these maps and images as base maps behind your fieldcollected coordinates from a GPS (Global Positioning System) receiver. You could also drape the maps and aerial photographs on a 3D digital elevation model (DEM) to visualize the Earth as it truly exists, in three dimensions.

Conclusion

Aerial photographs are important tools in geography education. It increases students' interest to the lesson and their analysis skills. They help students

to see the world from different perspectives and they are powerful tools for studying the Earth's environment. Aerial photographs can be used in teaching population, settlements, vegetation, landscapes etc. Matter in geography lessons. In the conducted studies it has been seen that aerial photographs increase children's map using skills and improve understanding and usage of aerial photographs for children of school age. Thus, it is beneficial to start using aerial photographs beginning from primary school stage while teaching geography.

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