

Using the «Abris» Business Game Technique in the Study of Engineering Disciplines

The application of modern techniques and special equipment in the educational process

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Abstract

The article deals with the use of the business game «Abris» in order to teach students how to plot an outline of a land plot using photos of a quadcopter, with the possibility of viewing each part of the plot in a more fragmented and more detailed way. The technique of the game is that the student needs for a limited time to draw the outline of the area, which was shot using a quadcopter. The student is given a plot of 300 x 300 meters of settlement type. The survey was conducted on top of the whole plot, as well as in parts, for a more accurate assessment of the situation. In the form of a business game there is an opportunity to explain to student-surveyors the definition of "outline", to teach them to draw and understand, to point out all the nuances of performing creative work. The game was developed aiming at students-surveyors studying the subject of "topographical and land survey drawing". Today, engineering graphics trains not only engineers, but really broad-minded specialists who have the developed spatial thinking and imagination, which allows them to solve many problems, finding various options, and even the most extraordinary ones.

Keywords:

Abris
Quadcopter
Business Game
Topographic and Land Surveying
Engineering and Computer Graphics

Schlüsselwörter:

1 Introduction

Globalization and advances in information technology has prompted a need to change traditional lecture-based passive learning methodology to an active multi-sensory experiential learning methodology (Deshpande Amit, Huang Samuel, 2011). The modern educational process requires orientation of the content and technologies of training on the development of the personality of the future specialist, which would be aimed at professional enhancement during professional training. Educational technologies are constantly evolving and characterized by the emergence of increasingly interesting interactive formats. One of these formats is a business game. This format is increasingly used in the process of training specialists of different profiles, which is due to the ability to simulate real situations in the learning process and translate the educational process into a practical plane.

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The game is one of the activities whose importance lies not in the results but in the process itself. Promotes psychological discharge, stress relief, harmonious inclusion in the world of human relations. Play is an integral part of everyone's life. The gameplay recognizes important and complex moments in society. In education, the same concept is used as a business game – a method of simulating situations that simulate professional or other activity through play, according to the rules. It is used for training and research purposes. From a pedagogical point of view, the business game allows to form in the future specialist more realistic ideas about the practical side of their future specialty and about the relationships in the team of employees, characteristic of the profession (Pavlov E.G., 2015).

Business game is a kind of modeling of processes and mechanisms of decision-making using different models and group work. The use of business games in the learning process promotes the development of students' professional competencies, develops the ability to reasonably defend their point of view, to analyze and interpret the information received and to work in a group. Business play also helps to develop certain social skills and nurture proper self-esteem (Kuprikova O.V., 2006).

Students of higher educational establishments of Ukraine, studying in engineering specialties like no other should be able to "read the drawings". They may not know foreign languages, but it is necessary for them to understand the language of the drawing, which is common to all.

The outline in the shooting and measurement works indicates a schematic plan made by hand, indicating the field measurements required to build an accurate plan or profile. The outline performed by the land managers does not reflect the true size of the objects on the plot, it is used to display the numbering of the topographic survey points and the object represented by that point (building angle, tree, hatch, etc.).

Thus, the outline gives a generalized, reduced picture of the terrain, allowing surveyors to have an idea of the land, its nature and features. Due to the outline of the field camera processing of field surveying data, the surveyor is able to determine the belonging of picket points to a particular site. Therefore, a beautiful, properly and neatly executed outline plays a very important role. That is why there is a need to teach students, future surveyors, the language of graphics, especially topographic drawing, which is an integral part of their profession.

A true specialist should be able not only to "draw" the site independently, but also be able to read the drawings of his colleagues, and not only in his specialty, because every engineer must know the language of drawing, which is what such science as engineering graphics is aimed at.

The game is designed for students – prospective surveyors studying the subject of "topographic and land drawing".

The relevance of the article is to explain to students-surveyors the definition of "outline", to teach him to draw and understand, to point out all the nuances in the conditions of business game.

Scientific and practical significance of this work: It is proposed to create an outline of a land plot by photographs of a quadcopter, with the possibility of viewing each part of the plot in a more fragmented and more detailed way by students in the form of a business game.

2 Theoretical foundations for the game

Playing cognitive activity helps the teacher to form in students a certain system of skills, which contribute to improving the quality of training of future specialists. The main pedagogical tasks today are the formation of cognitive activity, students' interest in the profession and their involvement in the process of self-education. Equally important is the task of communicative nature, because the learning process takes place in the context of communication between the teacher and the student (Belkin I.V., Tsivak Yu.Yu., 2010).

The business game is aimed at developing the ability to analyse specific practical situations and make decisions, during the game develops creative thinking, as well as honing the skills of assertive communication (Yavorska J., 2005).

Recently, business games have been widely used in various fields of specialist training in higher education. The business game is based on a simulation model that is realized through the actions of the game participants. At seminars with the practical use of game technology, the students' knowledge is deepened and consolidated, and the ability to apply them in practice is improved. Note that, in general, gaming activity performs the following functions: communicative (mastering the dialectic of communication), game therapy (overcoming difficulties that arise in different types of life), diagnostic (promoting self-knowledge), socialization (inclusion in the system of social relations) (Pavlov E.G., Egorova N.V., 2016). The business game enables students not to be

afraid of mistakes and to activate their own creative potential. Participants of the game become specific carriers of industrial relations, which are formed in the team.

In the course of conducting this business game the following educational tasks are solved:

- Student activity is developing;
- The ability to analyze specialized literature is formed;
- Activates students' creative thinking;
- The ability to virtually evaluate the material received is developed;
- Practical skills of land plot outline are instilled.

In the business game, the teacher acts as the organizer, the consultant, who never "closes" the process by itself in organizing and conducting the business game is establishing relationships between the participants, their interaction and cooperation. Only the joint efforts of the participants of the game for which they take responsibility allow to achieve results (Kuprikova O.V., 2006).

The source material for conducting an Abris business game is photographs taken with a quadcopter or otherwise unmanned aerial vehicle.

In recent years, drones have been increasingly assisted with the photogrammetry technique known as motion structure (SfM), where 2-D images have been transformed into 3-D topographic surfaces. This technique provides high-resolution topographic imagery, which can be used to augment existing topographic data (Kelleher C., Scholz C. A., Condon L., Reardon M., 2018).

Measurement and aerial photography of the terrain carried out by unmanned aerial vehicles is today an actual and cost-effective solution to most issues in the field of geodesy and topography. UAV for geodesy, flying on the specified route both in automatic and semi-automatic mode, receives accurate and reliable photos and video materials about the features of the terrain on which construction works will be carried out, performs ground-based laser scanning, conducts geological exploration, monitoring of buildings and structures. Obtained data from a drone in geodesy are processed in specialized software and are the basis in the design of construction, creation of digital and electronic maps, drawing up topographic plans of the terrain. A significant contribution of UAVs is made in conducting geodetic surveys for construction. Surveying drone provides experts with data that allow you to study the terrain of interest and to develop the design of construction, taking into account the rational use and environmental protection, to predict changes in the natural environment of the site under the influence of construction and operation of enterprises (<https://smartdrones.ua/blog/drony-v-stroitelstve-plyusy-i-plyushki>).

During the shooting of the characteristic points of the terrain, an outline is drawn with the drawing of all the rails with it depicting the relief and the situation. The outline is made in the journal of tacheometric shooting separately for each shooting point, and the direction and distance are applied "to the eye" without scale (Glushenkova I.S., Postoyenko O.V., Umnicin V.V., 2013). The outline is an important element of the tacheometric survey, as it allows you to reproduce the topography and the terrain situation during the preparation of the topographic plan in the course of a camera (Subotsky V.P., Sokolova V.V., 2010).

Unlike the contours used for theodolite surveying, the tacheometric survey does not indicate any dimensions (for speed of work), but the numbers of shooting points and rails are required. The results of all measurements according to the definition of the altitude of the shooting points are recorded in a special field log – the tacheometric recording log (Subotsky V.P., Sokolova V.V., 2010).

When filling the tacheometric journal, the numbering of the shooting points of the rationale is taken in Roman numerals (Glushenkova I.S., Postoyenko O.V., Umnicin V.V., 2013). Rail points are denoted by Arabic numerals, both in the log and on the outline, the shooting points and the rail points are denoted by the same numbers, which makes it possible to limit in outline only the numbering and location of the points without any digital characteristics. The numbering of track points with a total number of less than 1000 is taken through for the entire shoot to avoid confusion in camera processing. When the total number of points is greater than 1000, every next thousand are numbered again starting from one (Odaryuk T.S., Rusina N.G., Baseniuk T.I., 2010).

The measurements are recorded at each shooting point of the rationale in the following order:

- in the title of the letter indicate: the number of the shooting point from which the details are taken; rangefinder coefficient; height of the device; direction of orientation (the number of the point of the shooting base on which the device is oriented); zero (MO), which is determined at the beginning of each business day; height of shooting point;
- after pointing at the rail record a long distance; pointing height (at pointing height that is equal to the height of the device, enter the letter "/" in the corresponding column);
- releasing the dictionary to the next point, record the count in a vertical circle;

- record the count on the limb of the horizontal circle; apply a track point to the outline or record its semantic characteristic in the "Notes" column of the tachometer.

In practice, a specialist inventory technician often has to deal with surveying sites and buildings at the same time. Therefore, he needs to know and be able to perform all the work related to the inventory of buildings (drawing technical description, drawing work on the outline, drawings of land and buildings) (Vostokova A.A., Koshel S.M., Ushakova L.A., 2002).

The outline consists of a hand such that the buildings and structures depicted therein are close to the real one and are of relative magnitude.

When drawing the outline, avoid the wrong images, in which are large in nature, would appear on the outline smaller, at least this discrepancy and due to the corresponding size. Violation of the approximate scale leads to wrong visual perception and is often the cause of difficulty in overlaying and drawing the plan of the land plot in a fixed scale (Tretyak A.M., 2006).

On maps, plans and outlines, terrain features are represented as mapping symbols. Cartographic Symbols - a system of symbolic graphic marks, used for the image on the map of any objects and phenomena, their qualitative and quantitative characteristics (Perperi A.A., Viktorov O.V., Savielieva O.V., 2019). They give the appearance of a smaller copy of the depicted object for better memorization and readability of the symbols.

Symbols are divided into large-scale (outline), out-of-scale and explanatory.

1) Scale refers to the symbols that are local objects, the dimensions of which are expressed in scale map and can determine the area of such an object, so thanks to such signs on the plans and maps we can determine not only the position of the object, but also its sizes (Shargar O.M., Stukalsky V.P., 2013).

The boundaries of the site objects on the plan or outline can be represented by solid lines of different colors: black (buildings and structures, fences, roads, etc.), blue (reservoirs, rivers, lakes), brown (natural relief forms), light pink (streets and squares in settlements) etc.

The dotted line is applicable to agricultural and natural land boundaries, embankment boundaries and roadside recesses.

The boundaries of clearings, tunnels and some structures are indicated by a simple dotted line.

2) Extras are called symbols that represent objects that cannot be displayed on a map scale (Shargar O.M., Stukalsky V.P., 2013).

The exact location of the object in the terrain is indicated by a major point beyond the large conditional sign (Tretyak A.M., 2006). The main point is:

- near the symmetrical signs – in the center of the figure;
- near the signs with a wide base – in the middle of the base;
- near the signs having a base in the form of a right angle – at the top of the corner;
- next to the characters that are a combination of several shapes – in the center of the bottom shape.

3) Explanatory symbols are numeric and alphabetical inscriptions that characterize objects (stream direction, marsh depth, vegetation type) and serve to further characterize local objects. They are used in combination with large-scale and out-of-scale conditional signs (Shargar O.M., Stukalsky V.P., 2013).

One of the important features of the map as a smaller image, as opposed to aerial photography, painting, drawing, and other artistic image – the use of conditional signs for the transfer of objects, phenomena and processes of real reality (Korduba Yu.G., Smirnov E.I., 2007). The signs communicate with the objects they have marked. Map signs as special graphic symbols have the following properties: show the type of object on the map.

- determine their spatial position and location;
- allow you to interpret knowledge about objects and phenomena – their qualitative and quantitative characteristics, status, relationships, dynamics, etc.;
- are the means of formalization and systematization of knowledge;
- serve as a way of forming concepts, scientific abstractions, that is, a means of theoretical research.

The role of signs in scientific knowledge has been deeply revealed by the mathematician and philosopher Leibniz: "The general art of signs or the art of marking is a wonderful guide, since it unloads the imagination ... Care should be taken to make the markings convenient for discoveries ... then the work of thought is reduced in a meaningful way..." (Korduba Yu.G., Smirnov E.I., 2007).

The formation of many scientific concepts would be impossible without the introduction of systems of signs and their operation. Bypassing creative thought processes, they facilitate the penetration of complex and hidden connections. Map signs operate within the sign system.

A character system is a set of symbols used on a map of a certain scale, purpose, content and nature of use. Map signs are a formalized graphic language of the map and form one of the visual sign systems. Cartographic language, like other artificial languages, serves as a form of indirect expression of ideas and ancillary tools of communication (Shargar O.M., Stukalsky V.P., 2013).

Sign systems of all artificial languages are interpreted in verbal language. Natural language is universal and is the main form of cognition and communication. Without it, it would be impossible to create any symbols. The laconic character of conventional signs in comparison with the words of the common language creates the possibility of faster operation of concepts (Shargar O.M., Stukalsky V.P., 2013).

The advantage of symbols is that they not only reduce, but also direct, the thought that leads to the discovery of such spatiotemporal connections and relationships, the knowledge of which by means of the word language would be extremely difficult. The peculiarity of cartographic language is the use of symbols on the map in combination with the natural language of words, which can be signatures of different types and sizes (Shargar O.M., Stukalsky V.P., 2013).

3 Technique of conducting business game "Abris"

The essence of the game "Abris" is that the student needs to draw an outline of a plot, which, according to legend, was already removed with the help of a quadcopter. The student is given a plot of 300 x 300 meters of settlement type. The scale is set to 1:2000. The survey was conducted on top of the entire site, as well as in parts, for greater accuracy of the situation. Simplifying the problem, points were obtained on the photographic material that correspond to the crosses of the intersection of the coordinate grid after 100 meters.

The student will need an A4 sheet of paper, a ruler and pencils of different rigidity. So, as the scale of work 1: 2000, the real side on a piece of paper will be expressed in 15 centimeters. It is necessary to draw a square of 15 x 15 centimeters, with crosses of intersection of coordinate grid every 100 meters – 5 centimeters on the outline, respectively. Prior to the beginning of the work, the student must familiarize themselves with conventional topographic signs.

A CD containing one file, the Abris Project, is attached to the work. This file contains pictures of the area. Working (i.e., from which the student takes information) are 2, 4-30 photographs (slides).

The second slide (Fig. 1) shows the top view of the entire land plot. In order for the student to understand more precisely what and where it is located, the picture shows brown squares - the boundaries of the plot, and four points – the centers of intersection of the lines of the coordinate grid.

In the third slide, the whole section is divided into nine parts (Fig. 2). Starting from the fourth slide (Fig. 3) to the end, the top view of each part is given, and then what can be seen from the ends of the main diagonal of each part of the section. (Fig. 4), in order to be able to more accurately determine the essence of the subject in the photograph. In the top view, an approximate square (100 x 100 meters) in black, translucent color, and brown dots are the center of intersection of the grid lines. After the end of the work time the student has in their hands an outline, which must be verified with the second slide of the file.



Fig. 1: Top view of the selected area.



Fig. 2: Divide the selected area into squares.



Fig. 3: Top view of the first square of the divided section.



Fig. 4: Side view of the first square of the divided plot.

The teacher on the projector turns on the presentation with the photos that were taken by the quadcopter. The first photo is a view of the whole section from above, which is divided into nine equal squares, taken by a quadcopter from different angles, for a better view of all the elements of the terrain. Students sketch the entire area, using the symbols on the outline to indicate the largest elements of the area (rivers, roads, gardens, buildings and structures, settlements, fields, communications, etc.).

In the next step, the teacher moves to each square individually so that students can see in more detail all the elements of the terrain and draw with the symbols on their outline. So, if you look at the first square, you can see two buildings, a garden, a fence and shrubs. The next slide is a view of this square from the side, and you can see what these buildings, the garden, the fence, also shows that there is a drying river and a pillar for the power line.

By drawing the first part (the first square), the teacher switches the slide to the second square, and there we see lonely trees, bushes, and part of the road. The photo of this square on the side shows that there is a drying river, you can see how many single trees, you can understand which road, we also see a pillar for power.

In the third square we see buildings, a fence, part of the road, a lone tree and stones. The photo of the square on the side shows a courtyard with part of an asphalt road, a brick and stone fence, bushes and a number of stones. In the fourth square we see a building, a fence, several bushes. The photo on the side shows a courtyard, a stone fence, clearly visible where the bushes and stones are located.

The fifth square shows that the drying river is split, single trees, part of the road, bushes and shrubs. The photo on the side shows the trees, the number of bushes, the stone fence and part of the field road, as well as a pole for the power line.

In the sixth square we see a building, a road, a lone tree and bushes. The photo from the side shows that the building is wooden, one-storied, not fire-proof and is followed by a field road, the location of the bushes and the power line pole.

In the seventh square we see the buildings, the fence, part of the paved highway and also a part of the reinforced concrete bridge that is built over the river. The photo from the side shows that the buildings are one-storied and not fireproof, we also see the destroyed building, and we see that the river originates from the sea.

In the eighth square, we see the continuation of the paved road and the reinforced concrete bridge, as well as the beginning of the paved road, buildings, single trees and a fence. The photo on the side shows that the buildings are two-storied, stone, residential, concrete fence, bushes and shrubs.

In the last ninth square, we see a continuation of the paved road and a lone tree, also part of a concrete fence.

If we perform all nine squares in stages, carefully drawing the elements of the terrain that occur in each square and arranging them into a single whole square, then we will get a finished, complete outline of the given terrain, which will allow us to have an idea of the terrain, the location of all elements, their approximate size and position relative to each other (Fig. 5). The correctness of the outline is independently verified by the photo of the section above, which is on the second slide in the file.

4 Conclusions and Prospects

Game activity is a natural need, it is necessary to better navigate the life situation. The game is a model of behavior that develops directly in the learning process. It always has a purpose like work has. In the course of the game, the student emerges from the role of a passive listener and becomes an active participant in the learning process, combining knowledge and skills. The activity is manifested in the independent search for the means and ways to solve the problem, in the acquisition of knowledge necessary for the practical tasks. Moving away from the standard thinking, the stereotype of actions allows to develop the desire for knowledge, creates the motivation for learning.

Thus, the business game can be effectively used to develop students' ability to create land outlines. Outline is an integral part of the field surveying, so every student – a future surveyor – must understand this concept and be able to draw it. The outline is an important element of tachometric photography because it allows you to reproduce the topography when creating a topographic plan. Therefore, it should contain the basic forms of relief in the conditional horizontal directional arrows. The outline contains the position of all rack points, as well as the basic elements of the terrain: land outlines, buildings, name.

To be able to reproduce the whole situation on a sheet on the terrain, it is necessary to refine your skills, to have a variety of drawing techniques, which is a great merit of engineering graphics, and conducting the described game helps to master this discipline more effectively.

The experience gained from playing games proves that it is advisable to continue using the proposed methodology as an effective tool for teaching students to prepare them for future professional activities in geodetic practice.

Engineering business games are a useful tool to help the teacher in training really wide-ranging specialists who will have the developed spatial thinking and imagination, which allows to solve many problems, finding different options, and even the most unusual ones, to get several correct answers to the tasks. Such a specialist will solve the problem without much difficulty.

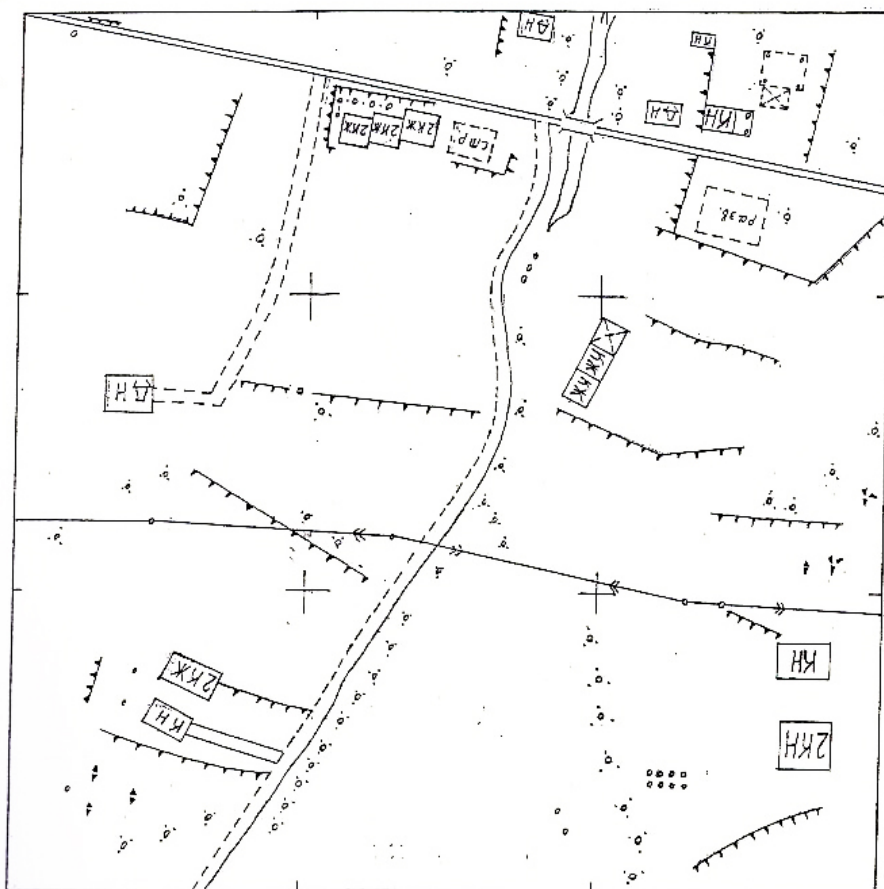


Fig. 5. Outline of a given plot of land.

These days it is not enough to reproduce what you see, it is necessary to have understanding and spatial thinking, a good idea, so that problems do not lead you to a dead end, flexibility of thinking, that is what distinguishes a modern good specialist, why and focused engineering graphics.

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