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The Application of Computer Programs Supporting the Handwriting Expertise for Consultative Purposes and in Teaching the Forensic Science

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Abstract

The article addresses the issue of using computer programs forming the package called GLOBALGRAF in order to perform handwriting examination. Not only are the aforementioned programs used for handwriting expertise by experts, but they can also have application in university education, and more specifically, in teaching forensic science to students.

In addition, the article attempts to show the practical aspect of forensic science teaching, using the aforementioned package named GLOBALGRAF, which undoubtedly responds to the needs of modern university education.

Keywords: GLOBALGRAF**,** GRAFOTYP, RAYGRAF, KINEGRAF, SCANGRAF, handwriting expertise, forensic science, university education, computer programs.

Introduction

Taking into account the undisputed contribution of forensic science to the fight against crime and other social pathology phenomena showing a significant crime-inducing impact, it is necessary to express the conviction that practical skills in this field of science have to be constantly increased.

Pointing to the non-theoretical aspect of forensic science, the opinion of Czeczot and Tomaszewski (1996, p. 16) should be quoted, who define it as 'a practical science that develops principles of efficient operation, the use of technical and laboratory research methods for preventing and detecting crimes and establishing facts which are relevant as an evidence in a criminal trial (preparatory proceedings, proceedings before the court, or other, e.g., civil proceedings)'.The practical aspect of forensic science is also confirmed by T. Hanausek who describes it as 'a science about tactical principles and ways as well as tech-

nical methods and means of detecting legally defined, negative social phenomena, and especially crimes and their perpetrators, and proving the existence or the lack of connection between people and events; likewise preventing crimes and other disadvantageous, though legally relevant phenomena' (Hanausek, 2009, p. 20). This corresponds with the opinion of Widacki (Widacki, Konieczny, 2008, p. 3) who claims that the aim of forensic science is'to develop effective methods of detecting crimes and their perpetrators as well as improving techniques of evidence collection'.

The above statements should be supplemented with Sławik's (2003, p. 17–18) opinion, according to which 'in pursuing its goals' [forensic science]draws on knowledge and methods from many other disciplines, e.g. medicine, psychology, psychiatry, biology, physics, chemistry, mathematics, statistics, cybernetics, electronics. However, it has most in common with criminal law (material and procedural one), criminology, and victimology'.

Forensic science is undoubtedly one of those fields of knowledge that are characterized by unusual dynamics, rapid development and the need for employing more and more innovative research methods and techniques, driven, in a sense, by necessity. This applies to various fields and specialties of this science, including handwriting expertise.

Application of Computer Programs in Handwriting Examination

In recent years, computer methods falling within the scope of the so-called graphometry and scanography as well as new techniques instrumentally used for handwriting examination, such as sequence determination (Goc, Łuszczuk, Łuszczuk, Tomaszewski, 2016, p. 13), have been developed. It should be emphasized that graphometry tests basic, measurable (geometric and metric) handwriting parameters such as, for example, lengths, widths, angles of inclination, curvatures, surfaces, letter density coefficient, and impulse factor (Łuszczuk, Goc, Łuszczuk, 2018, p. 13). When it comes to scanography, it should be regarded as the result of a search for a testing method that would allow to examine and compare handwriting features resulting from its motor and structural characteristics by analyzing bitmaps (pixel structure) of a digital image, reflecting the sequence and colour content of the drawn lines in the different parts of a specimen. This allows, i.a., to assess the amount of pressure exerted on the surface by the writing instrument. In natural writing, this results from uncontrolled writing habits characterized by a relatively high level of individualization and some kind of graphokinetic stability. According to handwriting experts, the shading and pressure of handwriting are perceived as features difficult to imitate, thus being useful for verification of the authenticity of the studied graphicism. In this case, a text sample - treated as a bitmap - is subject to cyclical transformations which reveal the distribution of pressure over the surface under the writing instrument (Łuszczuk, Łuszczuk, 2012, p. 226; quoted after Łuszczuk et al., 2018, p. 13).

The level of innovativeness of the mentioned techniques opens a new path for developing handwriting expertise and allows to talk about a new research methodology within the framework of the graphic-comparative method (Goc et al., 2016, p. 13). In terms of technological and methodological solutions, two packages of computer applications supporting handwriting examination, known as GLOBALGRAF, are most advanced in Poland.

The first of the aforementioned packagescalled GLOBALGRAF I, is the result of a joint scientific venture of the Polish Forensic Association and the University of Warsaw (Development Project No. OR 00003807 entitled: 'Development of methodologies and programs and construction of a stand for handwriting and signature identification using computer graphometry', completed in 2009-2011) and serves for analysis of selected graphometric features and description of some motor properties of handwriting (Goc, 2018, p. 33). It consists of the following programs: GRAFOTYP, RAYGRAF, KINEGRAF AND SCANGRAF (Łuszczuk et al., 2018, p. 13).

GRAFOTYP is a computer program that enables easy comparative analysis of such graphometric properties of handwriting as the following ones: the shape of the handwriting (signature) specimen area, i.e. the contour resulting from connecting its outermost points with straight lines, thus creating a specific geometrical figure; the shape of the baseline selected for analysis of a handwriting (signature) specimen; the shape of the top line of a handwriting (signature) specimen. It also allows to compare the level of grafotyp match between the examined specimens, which the program name is derived from (Goc, 2016, p. 246).

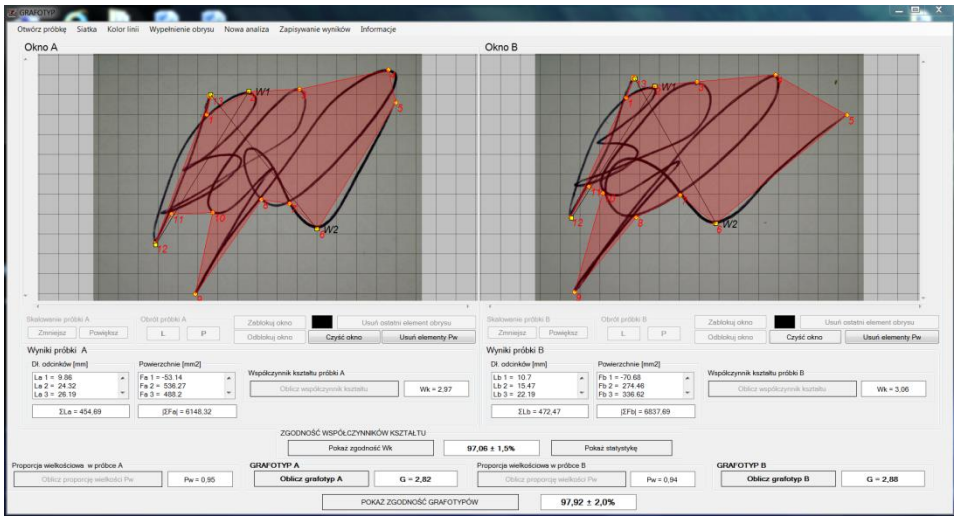

Fig. 1. The example of the GRAFOTYP program interface during the analysis

The author of the figures: M. Goc.

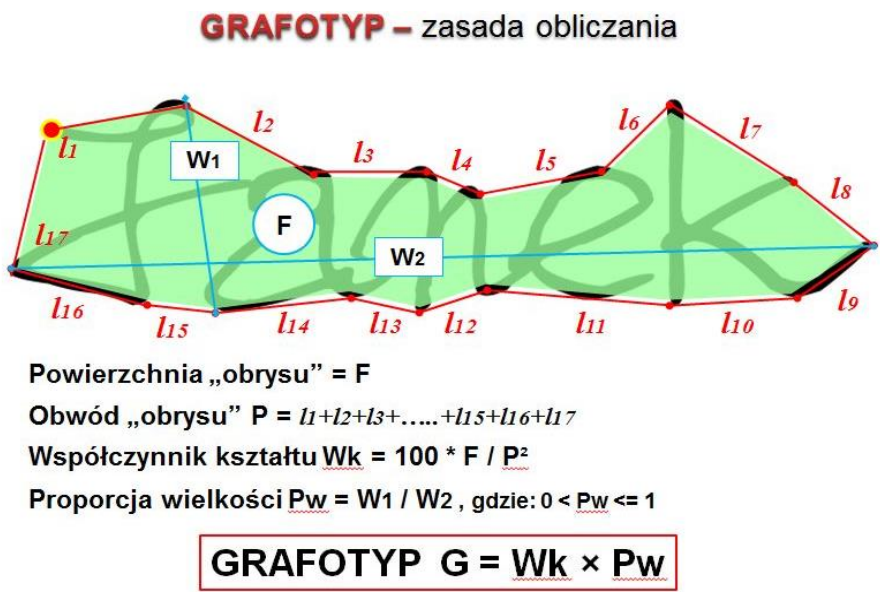

Fig. 2. The way of outlining a graphic figure in the GRAFOTYP program

The author of the figures: K. Łuszczuk.

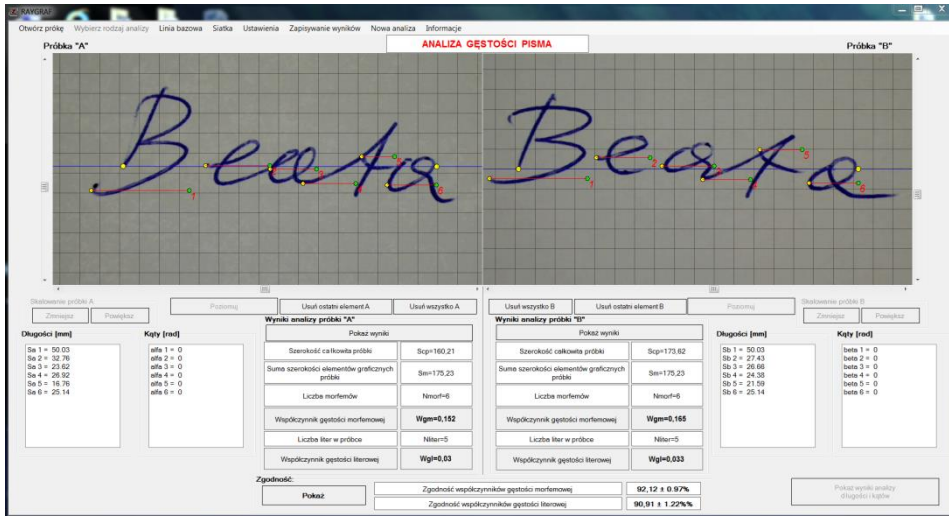

Fig. 3. The RAYGRAF program interface on the example of the handwriting density analysis

The author of the figures: M. Goc.

The second of the programs being a part of the GLOBALGRAF I package is called RAYGRAF. It enables the verification of the structural and geometric parameters of handwriting. Thanks to this program, it is possible to analyze the

properties of the juxtaposed samples of handwriting, such as the length of sections of the graphic line which allows one to determine the so-called linear similarity coefficient; the inclination angles of graphic elements which are used to measure the angular similarity coefficient; the density of handwriting as well as the density of handwriting impulse. The compatibility ratios of the analyzed coefficients in the compared samples are expressed percentage-wise (Goc, 2017b, p. 276–277).

KINEGRAF is another program included in the discussed package. This program facilitates the process of verification of the kinetic and geometric qualities of handwriting. It helps to evaluate the congruity of handwriting samples taking into consideration the parameters of selected graphical elements such as direction of writing (there are 10 directions of writing that have been distinguished: 8 straight and 2 arched), the level of line curvature (the program defines selected elements as either straight lines or arcs) as well as their length (Goc, 2017a, p. 67).

Fig. 4. The way of marking the kinetic and geometric similarity index in the KINEGRAF program

The author of the figures: K. Łuszczuk.

The last of the programs which constitutes the package, namely SCANGRAF, does not correspond to graphometry since it does not measure any qualities of handwriting. Its purpose is to visualize the motor features of handwriting, such

as shading and pressure. In order to do this, scangraf utilizes the method of scangraphyaforementioned in the introduction of this article (Łuszczuk et al., 2018, p. 13).

The programs discussed above have been used by experts during their practice for several years now and have received plenty of positive opinions. There is also a second package named GLOBALGRAF II. It consists of other four programs called BARWOSKAN, CENTROGRAF, LINIOGRAPH AND PROFILOSKAN (Łuszczuk et al., 2018, p. 13, 23; Goc et al., 2016, p. 21–28). They are currently being implemented by experts.

Forensic Science in University Education

Taking into account the possibilities of the above mentioned programs and the way of their professional usage by experts of forensic science, one should definitely emphasize their educational value, which can be extremely advantageous while teaching this subject at universities. This field of study has become a major in some of the degree courses. There is also an increasing number of postgraduate studies in this field being offered which highlights the scientific and practical importance of forensic science.

All of the above confirms the opinions of both potential employers and the academic community itself that it is crucial to develop a variety of educational forms, including practical education. The programs of Polish Forensic Association mentioned in the article fulfil a relevant function in this area.

Within the application submitted to the National Center for Research and Development (Single Integrated Program of the University of Rzeszów - the Way to High Quality Education; number and name of the Priority Axis: III. Higher Education for Economy and Development; number and name of the Action: 3.5 Congeneric University Programs), it became possible to equip the Laboratory of Criminalistics and Criminology at the Faculty of Law and Administration of the University of Rzeszów in a package of GLOBALGRAF I programs.

There were trainings for the employees of the laboratory on handwriting expertise held by experts of the Polish Forensic Association as a result of the obtained project. Thanks to the trainings and the knowledge acquired during them, University of Rzeszów has now the opportunity to conduct practical classes for its students. The participation in trainings and workshops being held as part of the mentioned project will end in gaining an appropriate document confirming the skills and knowledge acquired during the course. It is worth noticing that during the workshops being conducted in the Laboratory of Criminalistics and Criminology, the following skills are practiced: professional, analytical and IT skills.

What is significant is that the programs can be remarkably useful for both Polish - and English - speaking students as well. This is thanks to two language versions being available.

Owing to the opportunity to learn the programs such as: GRAFOTYP, RAYGRAF, KINEGRAF and SCANGRAF, the students have the chance to be familiarized with the specifics of the handwriting expertise preparation as well as can be exposed to the standards of forensic experts' profession. However, it ought to be strongly stressed that the knowledge learnt by students in the workshops is only preliminary. In case one is willing to become an expert in the future, it is necessary to constantly improve and develop the knowledge and skills.

Summary

Speaking of forensic science as a field of law of the court (Pelowska, 2003, p. 297–305), one should bear in mind the knowledge of principles on the subject of use of personal and material evidence for justice (Horoszowski, 1958, p. 5). One of the most frequently used evidence in a criminal trial is the expert's opinion. Due to the significant number of crimes related to forgery, the demand for handwriting expertise specialists is invariably high. Modern research methods and techniques, such as the GLOBALGRAF program packages discussed in this article are of considerable importance in the model of handwriting expertise nowadays.

Nevertheless, it has to be highlighted that the usage of computer programs is only supplementary, and the final analysis of their results as well as 'the type and the level of final identification decisions are always a part of the expert's tasks' (Goc-Ryszawa, 2013, p. 60). For, unfortunately, daily practice is not free from some negligence. In Poland there is no standardized system to prepare the experts to perform their functions in court. The mistakes that happen occasionally, which have been confirmed in laboratory practice, including laboratories in institutions such as the Polish Forensic Society, result from not always satisfactory level of skills and competences of handwriting expertise specialists, who perform their duties without proper preparation, both theoretical and practical (Goc, 2016, p. 7).

The arguments provided above ought to determine the ongoing discussion on the contemporary role of the university education model and vocational preparation of university education graduates, which should consider the practical aspect of preparation for the chosen profession. This applies especially to people who plan their future carrier path with the forensic science which is independent on one side, but interdisciplinary on the other.

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