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The role of mathematical and computer simulation in probabilistic thinking style development

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Abstract

The main purpose of the article is theoretical substantiation, development and introduction into practice of teaching methods, means and forms of development of the probabilistic thinking style as a universal competency and a key structural component in the professional culture of a multi-skilled journalist via comparative qualitative research methods. As a result, the presented system of principles has made it possible to create a new didactic construct based on a dialogue of cultures. In conclusion, the principle of integrative

learning seems also promising in holding advanced training courses, workshops, and training sessions for traditional media specialists.

Keywords: Integrative, educational, environment, mathematical, training.

El rol de la simulación matemática y por computadora en el desarrollo del estilo de pensamiento probabilístico

Resumen

El objetivo principal del artículo es la fundamentación teórica, el desarrollo y la introducción en la práctica de los métodos de enseñanza, los medios y las formas de desarrollo del estilo de pensamiento probabilístico como una competencia universal y un componente estructural clave en la cultura profesional de un periodista con múltiples habilidades a través de comparativos. Métodos de investigación cualitativos. Como resultado, el sistema de principios presentado ha permitido crear una nueva construcción didáctica basada en un diálogo de culturas. En conclusión, el principio de aprendizaje integrador también parece prometedor en la realización de cursos de capacitación avanzada, talleres y sesiones de capacitación para especialistas en medios tradicionales.

Palabras clave: integradora, educativa, ambiental, matemática, formación.

1. INTRODUCTION

The thinking style of a professional should correspond to the thinking style of a particular age, to the modern scientific worldview. Peculiar features of the modern thinking style are non-linearity,

systematicity, predictability, the ability to generate unconventional ideas, flexibility, critical thinking, creative activity, the fundamental nature of interdisciplinary knowledge, and the ability to apply this knowledge in situations of uncertainty, increasing diversity and the effect of random factors. At the level of empirical ascertaining, the statement science entered a probabilistic world is widely acknowledged in both natural and human sciences. In addition, it is the natural science disciplines, especially mathematics, which should play a leading role in shaping the modern probabilistic thinking style (PTS) in students, which is commensurate with a probabilistic nature of the processes occurring in the world and is a key structural component of mathematical culture in general.

Integration of mathematical techniques into arts and humanities, including journalism, at the turn of the 20th century, has become common. Whereas in 2012 the emerging science named medialogy was referred to as a synthetic human science that draws on the fundamentals of cultural science and semiotics, philosophy and pedagogy, political science and management, now this term is defined as a generalizing science of mass media, representing a synthesis of the media theory as a dynamic system, the theory of journalism and the theory of managing media systems and media processes, which supplements them. The current understanding of the media theory is based on mathematical and computer simulation techniques that, according to the authors, will make it possible to predict the development of a dynamic media system and to manage it competently. As a result, a long-awaited conjugation of social and

humanitarian knowledge of journalism with natural and exact sciences will be accomplished.

1.1. Theoretical foundations and research methodology

The main content of the PTS is operation with concepts that are to be validated by means of credible reasoning: incomplete induction, analogy and conclusions from affirming a consequence to affirming a reason. In terms of ideas created based on logic and intuition, the PTS allows for evaluation of their probability, thereby giving a possibility to quickly make the best decision in challenging situations of choice and uncertainty. Back in the 1920s, American researchers noted that in the sociology of journalism, as in big sociology as a whole, a balance was established between several levels of analysis–empirical, sectoral, and theoretical, that were useful adjuncts to each other. Such a balance is impossible without the interaction of logic and intuition that make up the PTS. Intuitive and quantitative forecasts are essential methods and conditions for the productive activity of the mass media.

As an example, the authors use a prognostic mathematical model describing building a plan for broadcasting programs to ensure successful functioning of long-term media projects affecting human emotional sphere, and for effective formation of public consciousness (Kirillova, 2012). The mathematical model obtained by the author is focused on the fact that in order to improve the perception of information by the audience, interruptions in broadcasting are

necessary. The author offers approximate formulas to calculate the duration of such interruptions, the minimum number of missed broadcasts, depending on viewer memory, and the total number of broadcasts on air. Practical implementation of the model guarantees effectiveness (including economic) and continuity of a media project.

At first glance, it may seem that the PTS is a purely mathematical type of thinking. However, it has a considerable humanist component. In addition, many psychologists Poincaré (2018) established that the work of a mathematician is not just a mechanical activity built by logical laws with strictly determined analytical thinking. According to Poincaré (2018), the work of a mathematician does not only consist in making possible combinations according to the laws already known. The true work of a scientist consists in choosing these combinations, so as to exclude the useless or, rather, not even bothering to create them. All these combinations are formed by a subconscious mechanism after a long conscious analytical effort. A moment of choice, or an insight, as it is often referred to by psychology scientists, comes suddenly.

The right choice arises not only because of the sharp logic of a mathematician that he can apply after the choice when evaluating its results but due to a sufficiently developed PTS guiding this choice. In the case of social and humanities representatives, in particular, in journalism, the logical laws can be extensively combined with intuitive cognition and creative implementation format peculiar to art professions. The occupational prestige and value of the journalist

profession are in the reliability of the information provided and the ability to analyze, evaluate, and predict the results of its impact on the audience.

These competencies are formed only in the course of the mathematization of the theory and practice of journalism, accumulation of knowledge and mastering mathematical model approaches with regard to the media activities. Many authors see the principle of mathematical simulation in the modern media environment not only in knowing the nature of information influence on an individual, but also in revealing the mechanisms of information wars, in developing reliable ways of protecting information at different levels, in regulating media processes, and in designing media as a homeostatic system (Korkonosenko, 2018).

The PTS contributes to the formation of the more nuanced and profound attitude of an individual to the world and to themselves; it is essential in choice situations, which means it makes an individual freer, more active and independent. This thinking type is imperative for a specialist who is increasingly referred to as a universal journalist, that is, capable of creating a media product in convergence, understanding information needs and value systems of the target audience, having the skill of working with all types of media texts; mastering the modern media techniques and digital mobile technologies that enable one to work simultaneously for print and web-based mass media, television and radio broadcasting (Bogdanov & Mokhor, 2002).

The technological component of training a specialist that would be ready for professional application of the latest modern technologies no longer causes doubts, neither does their having to have a mindset aligned with the information communication challenges of the age, which would be formed as early as in their student days. A networked culture of society is characterized by the rapid development of social media as a new form of reflecting social consciousness, the network logic of information dissemination (network information flows and structures and their interaction), fundamentally new competencies in specialists, the formation of which is possible in new information and educational space.

Thus, the PTS development depends on active functioning and interaction of logical and intuitive components in the course of formal mathematical training based on a dialogue of cultures; on the formedness of structural elements of mathematical knowledge and generalized skills to apply this knowledge in the humanities during their professional task execution; on qualitative enrichment of the mental activity mechanisms, on the development level of mental operations, determined by a proactive approach of an individual to mathematical and technological activities. This analysis has allowed the authors to formulate a system of core principles that provide a methodological framework to improve single information and educational environment as a set of educational and digital content data and as a strategy for the development of new competencies, including the PTS:

- The principle of including probability in the structure and content of cognition takes into consideration mathematical and statistical regularities in the content and structure of learning process and their impact on the conceptual structure of thinking through simultaneous use of two different, incomparable, incommensurable types of thinking–the logical and intuitive ones, as well as emergent properties of their collaborative effect;

- The principle of mathematical simulation integrates the theoretical foundations of mathematics with their practical implementation and the ability to make mathematical models of media activities, whereby methodological, ideological, and professional problems are solved in the process of teaching students (Shlyapentokh, 1969);

- The principle of synergistic effect, its principle being the interaction and convergence of humanities, mathematical and information disciplines at different levels, whereby new synergistic effects emerge in procedural, content and personal manifestation contexts. Thus, this principle contributes to an in-depth study of several subjects at the same time, it requires the ability to think in global terms and to make an economic assessment of new results obtained based on understanding the system essence of all the phenomena and processes occurring in the world (Shesterkina, 2011);

- The principle of fractality, used as a methodological property, which allows for simultaneous consideration of different-scale

objects and processes with retention of an invariant. Application of the fractality principle makes it possible to present instruction elements in the form of fractal models, to establish interdisciplinary connections and relations in complex structures of educational subsystems, to assess the system status as a whole, to implement a procedure for assessing the educational process quality both in general and in particular based thereon, depending on the depth of interpenetration and intersection of growing fractal structures;

- The principle of transdisciplinarity unlocks potential for interaction, for synthesis of the results of different academic disciplines in solving multifaceted interaction issues between the two cultures, the natural science and humanities, as a productive dialogue of various academic fields and as a form of interaction between disciplines to facilitate comprehension of the system complexity phenomenon and creation of a new intellectual space;

- The principle of unity of educational and technological logic– consistent use of various information and didactic technologies that would solve specific tasks in different structural elements of an educational environment in single educational and technological logic;

- The principle of flexibility and adaptability of organizational structure– implementation of various options for building an

individual educational strategy, depending on the personality characteristics and potential of a student (Svitisch, 2010: Tambunan, 2019).

2. RESEARCH RESULTS

The presented system of principles has made it possible to create a new didactic construct based on a dialogue of cultures, taking into account the balance of differentiation and integration processes by means of introducing integrative courses and programs, thereby reducing the total educational content, forming skills and abilities for activities within a particular discipline, and moving to an interdisciplinary level. What is referred to as integrative courses are academic disciplines whose content is determined by the interrelation of several fundamental research disciplines and subject areas, a flexible presentation logic, a high degree of freedom in choosing forms and methods of teaching, and implementation of interdisciplinary structural and substantive links?

Previously, the authors created and introduced into the higher school teaching practice integrative courses, combining the humanities and the natural domain (Mikhaylov et al., 2015). The designed integrative course Mathematical and computer simulation techniques in modern journalism were included in the variable part of the bachelor-level program in senior years. It should be noted that the integrative course was created as a consequence of a situation where

the existing major problem of quantitative description of the functioning and development patterns of the modern media as a dynamic system in a converged environment was not feasible to resolve within a single discipline. The presented integrative course has been successfully introduced into the teaching practice in Yelets State University named after Ivan Bunin (Penskiy, 2016).

The objectives of the integrative course Mathematical and computer simulation techniques in modern journalism are the following: updating basic mathematical methods to describe information exchange processes in social structures (analysis, evaluation, forecast, conceptual generalization, simulation); expansion of profession-oriented scope of knowledge based on intensifying integration links with mathematics and computer science at multiple levels; developing the PTS in students as a universal competency of a future professional (Rastorguev, 2014). The proposed integrative course would contribute to the mutually enriching synthesis of scientific disciplines, the convergence of thought and action of future professionals and their efficient engagement into the profession. Possible content of the integrative course includes training materials from different areas of knowledge, including topics from mathematical, information and professional disciplines required to form universal competencies:

2.1. Mathematics as part of the journalist professional culture

The views on the mathematics of distinguished scholars of the past and present, their assessment of the role and place of mathematics, the methods of the discipline for solving professional problems in multiple spheres of human activity. General scientific and special cognition methods in mathematics and journalism. The probabilistic thinking style in professional journalist activities: its features, description, and methods of forming (Sukhodolov & Rachkov, 2017; 2010).

2.2. *Mathematical methods for collecting, reporting and analysis of information, used in the media practice*

The topics of the history of mathematical statistics. The scientists who have made a significant contribution to the establishment of statistics (studies of social phenomena laws by J. Graunt and Sir W. Petty). Ways of obtaining and presenting sociological data in journalist materials. Empirical data ranking. Empirical data grouping. Graphic representation of empirical data as an effective mechanism for visualizing information in the media. Methodology and technique for constructing graphs and diagrams in MS Excel (or in the statistical program SPSS or Vortex). Software and services for creating infographics in media texts (Many Eyes, Easel.ly, Infogr.am, Tableau). Sampling study management by a journalist. Requirements for a sample (uniform, repetition-free, representative). Formation strategies and the size of a representative sample. Studying

the sample and its description in the add-on Analysis Package in MS Excel (or in the statistical programs SPSS or Vortex).

Testing statistical hypotheses. Scientific and statistical hypotheses. Statistical comparisons in the Analysis Package add-on modes in MS Excel (or in the statistical programs SPSS or Vortex). Analysis of links and factors. Linear correlation. Features of the correlation analysis study using statistical functions in the add-on Analysis Package in MS Excel (or in the statistical programs SPSS or Vortex). Application of the multivariate analysis methods in preparation of journalist materials for various types of media (Maslov & Khaminova, 2016).

2.3. Mathematical methods for evaluating and forecasting information in journalist activities

The mathematical framework of simulation. Simulation problem statement. Classification of models. Mathematical models used in the social sphere. Mathematical simulation of functioning and development patterns of the media as a dynamic system: the Shannon-Weaver model, Lasswell's Magic Bullet model, the Schramm-Osgood cyclic communication model, the two-step media model, Robinson's model, Newcomb's model, etc. Prediction of communication processes using ICT. Passive and active forecasts. Method of expert evaluations, extrapolation method. Method of average. Linear regression method. Construction of regression equations and prediction of empirical data

using the Analysis Package in MS Excel (or in the statistical programs SPSS or Vortex).

Visualization of time variations and empirical data forecast using the services Many Eyes, Easel.ly, Infogr.am, and Tableau. Evaluation part in the structure of the integrative course Mathematical and computer simulation techniques in modern journalism contains final interdisciplinary projects, descriptions of their implementation, criteria and recommendations for correction of the result. To assess the mastery of the course syllabus, interdisciplinary tasks focused on the overall result were developed, and forms of organizing activities in small groups were proposed:

- For the journalist group to identify a problematic field of a media metric research, a subject, object and hypothesis of the research; to collect initial (factual) information using data collection techniques (questionnaire surveys, online and face-to-face polls); to develop the concept of a media product; to create a narrative text;

- For the analyst group to analyze empirical information based on descriptive statistical techniques; to study the dynamics and patterns of information and communication processes with the use of forecast methods; to carry out mathematical simulation of processes in the modern media environment and to explore communications;

- For the programmer and computer designer group to study social information with the use of Analysis Package in MS Excel (or in

the statistical programs SPSS or Vortex) and its subsequent transformation to render through the following services to create infographics in media texts (Many Eyes, Easel.ly, Infogr.am, Tableau).

For example, students were asked to develop a multimedia long read for the web version of a print media on the subject Yelets is a City of Military Glory. The mainstay of this format is a narrative article of artistic-journalist orientation that comes with infographics (graphical charts drawn up in MS Excel, transformed in the program Many Eyes and presented in the form of an animated image), video, photo and audio content created in the Vuvox program). To propose the developed media product for placement on the Internet platform of the periodical and to estimate a possible number of views (user hits) taking into account the average figure within a year (indicators of the central trend measure). Subject to the placement of advertisements on the website, to analyze the situation of its economic profitability for convergent media based on factor analysis using the Univariate Analysis mode in MS Excel (or in the statistical programs SPSS or Vortex).

3. CONCLUSION

Since the early twentieth century, the system of journalism education in Russia has undergone significant changes. This is related to the need for an adequate response to the challenges of modernity: the media industry development trend, whereby it awaits professionals

who would be able to work productively in the context of media convergence. Major technological changes in the mass media arena have caused new professional requirements for a journalist who is aware of their involvement in the global convergent process. The formation of competencies in a modern journalist in the process of university training is promoted by integrative courses similar to the one presented above.

Being an example of successful application of mathematical and computational techniques in the theory and practice of journalism, such integrative courses develop the probabilistic thinking style that is most aligned with the state-of-the-art and the level of civilization. The principle of integrative learning seems also promising in holding advanced training courses, workshops, and training sessions for traditional media specialists who improve their activities, taking into account the characteristics of a convergent media environment.

4. ACKNOWLEDGMENT

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