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INCREASE OF THE LEVEL OF CRITICAL THINKING TO COUNTERACT DISINFORMATION AND MANIPULATION OF ARTIFICIALLY REPRODUCED MEDIA CONTENT: AN EMPIRICAL STUDY

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Abstract. This research examines the current issue of synthetically reproduced and modified content, including its use through the 'deepfake' technology and its potential threats to society. The authors highlight how this content alters our perception of reality, allowing us to explore the world, reproduce emotions and fill in information gaps. The text analyses the ethical aspects of creating and using synthetic content, the differences between positive and negative intentions, and various forms of its distribution, including video and audio. The study also highlights the new technologies underlying deepfakes and their possible consequences for society, including the increased threat of disinformation and manipulation. The effectiveness was tested using the method of mathematical statistics with the use of Pearson's criterion. The results of the study indicate that the methodology has a positive impact on the development of skills in recognising synthetically reproduced media content and the ability to avoid disinformation and manipulation.

Key words: Empirical Study; Educational Methodology; Deepfakes; Synthetic Media; Critical Thinking; Media Literacy; Disinformation; Fake News.

Introduction. Synthetically recreated and modified content, as well as content that uses deepfake technology, has become a part of our lives. This content allows us to explore the world, immerse ourselves in emotions, and fill in information gaps, supplementing reality depending on the intentions of the author or customer. Content is not a phenomenon in itself, but transmits certain information that is processed by the recipient and causes a response. At the same time, the intentions behind the creation of such fake products vary in their ethical characteristics. They may be positive and neutral (such as art, services, entertainment, etc.) or negative and criminal (such as discrediting individuals, legal entities or even entire states; provoking conflicts; committing offences, etc.).

The main form of deepfake content is a video created using a set of authentic data that «recreates» events that never occurred. The advent of this was aided, in part, by pattern identification systems (like those for pictures and layouts) which found success in facial recognition. Simultaneously, the growing capability of computers enabled the generation of remarkably lifelike visuals using ray tracing methods. Furthermore, the expansion of platforms for audio and visual content, coupled with a broader user base online, significantly boosted individuals' capacity to employ these tools (Chemerys et al., 2021a).

Audio is another form of deepfake content. The advent of voice cloning technology has enabled the creation of audio fakes that are more realistic than ever before. In order to create a sound product that reproduces not only the timbre of the voice, but also a set of unique language structures used by a particular person in his or her speech, the latest generation of natural language processing technologies are employed. These technologies allow for the identification and reproduction of the lexical and semantic thesaurus and manner of communication of the speaker through quantitative (statistical), linguistic and other approaches.

On the one hand, the phenomenon of counterfeiting is not a novel cultural phenomenon. By analysing the forms of its existence and the threats it poses, it can be stated that humanity has encountered similar phenomena for a long time. These include the Letter of Presbyter John, fake paintings and banknotes. The Letter of Presbyter John is considered a forgery created, according to one version, to persuade the participants of the Second Crusade to go to Mesopotamia. Consequently, it is only appropriate to discuss the advent of a new technological stage in the existence of an integral cultural phenomenon – deception. Prior to the advent of this technology, examples of video deception included any propaganda films that attempted to distort or replace reality with the one that the authors or customers desired. The falsification of video evidence is a related phenomenon. Nonetheless, the arrival of contemporary technological advancements has broadened the scope of dangers linked to deepfake methods, alongside the avenues for their beneficial application. Specifically, the deployment of deepfake visual media presents a serious peril for susceptible demographics, notably youngsters and those in their formative years, thereby furthering what is termed the «digital risk society». As generative technologies become increasingly indistinguishable from human input, concerns arise about their persuasive power–especially when «GenAI produced more consistent writing scores than HR did» (Topuz et al., 2025, p. 42), potentially reinforcing trust in content that lacks human oversight. The lack of critical thinking skills and the ready availability of information sources, particularly through the Internet, mean that young people may be exposed to the dangers of this technology in the form of various challenges. Women are also particularly vulnerable to the effects of pornographic deepfakes, which can cause significant damage to their reputation and mental state (Chemerys et al., 2021b).

On the other hand, new technologies facilitate the creation of highly realistic fake media products, which, in turn, makes them more challenging to identify and detect. The potential risks associated with deepfake technology are increasingly being discussed by experts from various fields, as the extent and scale of these risks continue to evolve (Chesney and Citron, 2019).

Lately, the widespread nature of untruths has become a major hazard for how we talk publicly, the good of society, learning, and how our democracies function (Borges et al., 2019, p. 4; Qayyum et al., 2019, 16). Fabricated material, styled like news and deliberately made to trick folk, is what we mean by false information (Aldwairi and Alwahedi, 2018; Jang et al., 2018). This misleading stuff spreads like wildfire across the digital world, leaping over national borders and capable of swaying countless users (Figueira and Oliveira, 2017). With video content becoming ever more common, we absolutely need to devise ways to encourage the public to think more keenly, so they can tell what's real and what's not in the news they see, all the more so because slick new tech makes it simple to manipulate moving pictures in a very convincing way (Anderson, 2018).

We are currently witnessing an explosion in digital falsehoods and information conflict, where deliberate campaigns spreading untruths are mounted with the express purpose of swaying what the populace thinks (Anderson, 2018; Qayyum et al., 2019; Zannettou et al., 2019). The development of advanced digital tools has made it much simpler to produce visual material that is highly engaging, thanks to «deepfake» methods. These allow for the smooth superimposition of one person's facial characteristics onto another's, yielding remarkably authentic images that are almost impossible to tell apart from genuine footage (Chawla, 2019, 4-5; Maras and Alexandrou, 2019, 256). The potential for deepfake tech to generate diverse material is substantial, spanning humorous clips, adult content, and political footage where people seem to utter words without ever having done so, their looks and voices having been modified at will (Day, 2019, 108; Fletcher, 2018, 455-456). Significantly, deepfake technology presents a major hazard because of its ability to create fake visual evidence for numerous aims. These cover undermining political structures, manufacturing bogus recorded proof for court cases, distributing extremist messages, enabling blackmail, swaying stock markets, and propagating untruths (Maras and Alexandrou, 2019).

To aid the fight against the spread of false narratives, the European Commission has opted to concentrate on updating the Code of Practice relating to Disinformation, as part of the broader framework governing the obligations and roles of online platforms. This action aligns perfectly with what is stipulated in the forthcoming Digital Services Act. Broadly speaking, the European Commission aims to roll out mechanisms that place greater accountability on both media operators and those receiving information directed at them, particularly in tackling the dissemination of falsehoods. The pressing nature of this matter is heavily emphasised by the multitude of regulatory texts and proposed laws concerning rules designed to safeguard national information integrity and uphold the entitlement to truthful data. The foundational tenets guiding the adoption and advancement of information, telecoms, and media advancements within Ukraine are clearly laid out in the Strategy for the Growth of Ukraine's Information Society (2013). To confront the difficulties presented by hybrid aggressions and the propagation of disinformation within Ukraine, the country has formally adopted and put into effect the Cybersecurity Strategy for Ukraine spanning 2021 to 2025. This strategy, bearing the title «A Secure Cyberspace – Crucial for the Nation's Prosperous Growth» constitutes a cornerstone in the country's push to bolster its cyber defences. Moreover, the National Security Strategy of Ukraine and the Ukrainian Law titled «Concerning National Security» (2018) hold a crucial position in these endeavours.

It's worth pointing out that on the 15th of July, 2021, various Ukrainian government bodies, alongside international representatives, met up under the auspices of the OSCE to thrash out plans for battling disinformation and bolstering information security. The central theme of these talks revolved around the world's leading methods for shielding our communities from the damaging fall-out of falsehoods and other sorts of hybrid manipulation. To this end, a few significant pieces of foreign legislation were taken into account, most notably the European Union's 2018 Code of Practice on Disinformation, and the European Commission's decision back in 2016 to enact a «Joint Framework on Counter-Hybrid Response» as part of the European Union's response (2016) as part of the EU's broader strategy.

The advent of simulated reality is upon us, and it is evident that this new phenomenon exhibits characteristics of hyper-realism (Chesney and Citron, 2019). The combination of cognitive biases inherent in all humans and the power of social media has created an environment conducive to the use of dipsticks. Given the psychological tendency of people to fall into the grip of cognitive stereotypes and prejudices, as well as the growing influence of social media, which instantly disseminates information, it is becoming increasingly difficult to distinguish between reality and pseudo-reality. That is why critical thinking to counteract disinformation and manipulation of artificially reproduced media content was developed to enhance the ability to recognise synthetically reproduced media content (Chemerys, 2024b; Chemerys, et al., 2022), which results of the implementation will be used to track the dynamics of skills development in detecting and recognising synthetically reproduced and modified media content and its effectiveness. To create a comprehensive base of methodological materials, a thorough review of existing markers of image falsification was carried out. The aim was to identify and catalogue the characteristics that indicate the manipulation of visual content, as well as to develop strategies for recognising synthetic media. This will further strengthen the foundations of critical thinking in our society (Chemerys, 2024a).

Methods. The study tested the effectiveness of critical thinking methodology in counteracting disinformation and the manipulation of artificially reproduced media content. The components and structural elements of this content were substantiated in the study. In the course of the empirical study to test the effectiveness of the proposed methodology, non-parametric methods of mathematical statistics in pedagogical research and methods of mathematical statistics in pedagogy by J. Glass and J. Stanley and others were used (Glass and Stanley, 1970; Fernberger, 1916; Sestir et al., 2023), where the experiment is defined as a complex research method that provides a scientifically objective and evidential verification of the correctness of the hypothesis justified at the beginning of the study. It

enables the assessment of the efficacy of specific innovations in the field of education, the determination of the relative importance of various factors in the structure of the pedagogical process, and the selection of the optimal combination of these factors for specific circumstances.

The primary objective of the empirical study was to substantiate the general and partial hypotheses of the research, to evaluate the methodology of critical thinking to counteract disinformation and manipulation of artificially reproduced media content, which components and structural elements of this methodology were empirically validated in the research.

In order to test the hypothesis that the level of critical thinking can be improved by applying the proposed methodology aimed at developing critical thinking to counteract disinformation and manipulation of artificially reproduced media content, including cognitive, activity, value-motivational and reflective criteria, an experimental study was conducted. In order to conduct an empirical study, we undertook a review of the methodologies and outcomes of research on a number of issues pertaining to the educational process in higher education (Sedelmaier et al., 2022; Gammon and White, 2011; Recepoğlu, 2015)

The empirical study programme was implemented during 2024-2025 to solve the tasks set. At the current stage, we compare statistic information of 251 respondents (from Zaporizhzhia National University; Municipal Institution of Higher Education «Khortytsia National Academy» of Zaporizhzhia Regional Council; Classic Private University; State Institution «Luhansk Taras Shevchenko National University», Interregional Academy of Personnel Management; Ivan Franko Zhytomyr State University; Volodymyr Hnatiuk Ternopil National University; Polissya National University). Our intended demographic comprised undergraduates pursuing degrees in the Pedagogy of Higher Education (given that this course of study encapsulates «lifelong learning,» thereby encompassing a varied age range) alongside those enrolled in visual media programmes (the «Design» speciality).

The empirical study aimed to assess the efficacy of the proposed methodology for critical thinking in countering disinformation and the manipulation of artificially reproduced media content. The investigation unfolded across a trio of phases: initial appraisal, development, and verification. The progress in bolstering critical thinking within the group that received no instruction based on this approach was contrasted with the experimental cohort, whose members actively took part in the methodology's training. During the verification stage, the intention was to scrutinise the experimental group's movement through both the initial appraisal and development stages, all to confirm the trustworthiness of the findings gathered.

The initial diagnostic stage of this teaching trial (running from November 2024 through to December 2024) is set to be executed with the purpose of theoretically examining the current situation regarding the aptitude for critical thought needed to resist false narratives and the tampering of artificially conjured media. This includes pinning down the standards and tiers of this ability. Leveraging the theoretical framework and initial data assembled, the research question, topic, primary aim, specific objectives, scope, focus, and underlying assumption of the study were then established. Furthermore, the foundational principles and techniques for the research were justified; the pressing need to elevate the populace's critical thinking skills was demonstrated; a framework for cultivating critical thought to handle disinformation and manipulated media was devised; the substance, techniques, tools, and structures for refining this framework were created; the metrics, signs, and degrees of its cultivation were specified; and a blueprint for the practical, experimental work aimed at building critical thinking was drawn up.

In conducting the pedagogical experiment, we met the requirements of validity, reliability and fidelity. As per the stipulations for an experiment to be deemed valid, elements such as the makeup of the participants, their proficiency level, and the environment in which the testing took place were kept identical across both the control and experimental groups. The sole point of departure was the introduction of the newly devised curriculum intended to bolster critical thought processes; this dis-

tinction precisely categorises the setup as a single-factor experiment. The requirement of reliability is ensured by leveling the basic conditions of the pedagogical experiment in real conditions. The study was designed to compare the results of the experimental group with those of the control group. The experimental group implemented the developed training programme, while the control group respondents were not involved in the training. As the measurement of the above indicators is carried out using different measurement scales, we considered it appropriate to bring all scales to four levels: critical (intuitive), acceptable (reproductive), sufficient (productive), high (heuristic).

To gauge the degree of critical thought necessary to combat misinformation and manipulation embedded in artificially generated media, assessed via the cognitive criterion, the researcher employed bespoke test questions devised by the author. These questions possessed unambiguous wording and offered a single definitive correct response, specifically targeting the capacity to discern synthetic media. The quantity of accurate responses furnished by the participants, alongside their resultant test score, signified a particular echelon of critical thinking as measured by the cognitive metric. Further, to ascertain the level of critical thinking deployed against disinformation and manipulation in synthetically reproduced media content, assessed under the motivational-activity and analytical-reflective criteria, established psychological self-assessment tools (Ahmed and Samuel, 2017) were utilised. The computation of the mean baseline level of critical thinking among the participants within both the control and experimental groups, recorded at the ascertainment stage of the pedagogical experiment, is detailed comprehensively in Table 1.

Table 1

The initial level of training of the respondents in the control group and in the experimental group at the stage of identification of the pedagogical experiment

Level	Control Group		Experimental Group	
	Persons	%	Persons	%
Level 1: Critical (Intuitive)	16	13,45%	18	13,83%
Level 2: Acceptable (Reproductive)	39	32,98%	38	28,98%
Level 3: Sufficient (Productive)	48	40,13%	59	44,32%
Level 4: High (Heuristic)	16	13,45%	17	12,88%
Total	119	100,00%	132	100,00%
Average score	3,5357		3,5625	

An analysis of the respondents initial level indicated that those in both the control and experimental groups held roughly comparable standings. Statistical appraisal, specifically employing Student's t-test (per Fay and Proschan, 2010), confirmed that the characteristics between the experimental and control sets are indistinguishable at the 0,05 threshold. Consequently, one can deduce that the groups are homogeneous. Referencing Table 1, the mean educational standing across both the control and experimental groups exhibits no statistically meaningful disparity, and their starting levels of critical thought are likewise identical. The majority of respondents in the control group have an intermediate level of knowledge (40,13%); in the experimental group – 44,32%. Thus, the foundational knowledge held by both groups is practically equivalent. In this case, two hypotheses are proposed: the null hypothesis (H_0), according to which the difference in the level of critical thinking between the respondents is not significant enough and therefore the distribution belongs to a general population, i.e. the sampling was carried out correctly; the alternative hypothesis (H_1), according to which the difference in the level of critical thinking between the respondents of the control and experimental groups is significant enough. The null hypothesis can be rejected in favour of an alternative hypothesis if the statistical analysis shows that the probability of finding the difference by chance does not exceed 0,05 or 5%. If this level of confidence is not achieved, the null hypothesis cannot

be rejected. Therefore, it is necessary to prove that the results of the pre-test to determine the initial level of training of the respondents in the control and experimental groups are samples from the same general population, which determines the correctness of the null hypothesis. Let's determine the value of the Student's t-test using formula 1:

$$t = \frac{M_1 - M_2}{\sqrt{\frac{S_1^2}{N_1} + \frac{S_2^2}{N_2}}}, \quad (1)$$

where M_1 and M_2 are the means of the control and experimental groups samples; S_1 and S_2 are the variance (standard deviation) for the control and experimental groups samples, respectively; N_1 and N_2 are the number of assessments in the control and experimental groups samples. Let's define the variance using formula 2:

$$S^2 = \frac{\sum_{i=1}^{n} (X_1 - X_2)^2}{N-1} \quad (2)$$

where, $(x_1 - x_2)^2$ – is the square of the deviations of the individual values of the features from the arithmetic mean; N is the number of features.

Dispersion is an indicator of how blurred the distribution curve is relative to its arithmetic mean. The calculation of the variance of the initial level of education of students is presented in Table 2.:

Table 2

Calculation of the variance of the level of critical thinking of the respondents

Groups	Level		Number of respondents	Arithmetic mean	Deviation from the arithmetic mean x_1-x_2	Square of deviations $(x_1-x_2)^2$	Product of number of scores times square of deviation $n_i(x_1-x_2)^2$	Dispersion
Control	Critical (Intuitive)	2	16	$\frac{421}{119} = 3,54$	-1,54	2,36	37,73	$\frac{93,6}{118} = 0,7932$
	Acceptable (Reproductive)	3	39		-0,54	0,29	11,26	
	Sufficient (Productive)	4	48		0,46	0,22	10,29	
	High (Heuristic)	5	16		1,46	2,14	34,31	
Expere-mental	Critical (Intuitive)	2	18	$\frac{470}{132} = 3,56$	-1,56	2,44	44,56	$\frac{102,9}{131} = 0,7861$
	Acceptable (Reproductive)	3	38		-0,56	0,32	12,10	
	Sufficient (Productive)	4	59		0,44	0,19	11,20	
	High (Heuristic)	5	17		1,44	2,07	35,13	

Having determined the dispersion value, let's calculate the value of t_{calc} using formula 2:

$$t = \frac{(3,5770 - 3,6288)}{\sqrt{\frac{0,7397}{119} + \frac{0,7861}{132}}} = 0,2384$$

After calculating the Student's t-test, let's compare it with the tabulated value. The tabulated value of the t-test is greater than the calculated value ($t_{table.}(1,984) > t_{calc.}(0,2384)$). This indicates that the null hypothesis is not rejected and that the two samples belong to the same general population, that is, they are homogeneous at the 0,05 confidence level. Thus, gathering the outcomes of our calculations, we are able to assert that the control and experimental groups are uniform and notionally equivalent. The findings gleaned from the establishment stage of experiment demonstrated that both sets of par-

ticipants displayed an inadequate grasp of critical thought processes. A summary of the diagnostic appraisal concerning the degree of critical thinking harnessed to resist misinformation and the manipulation embedded within artificially generated media, alongside the corresponding criterion across both the control and experimental groups during the establishment and formative stages of the study, is laid out in Table 3.

Table 3

The results of the pedagogical experiment on the dynamics of the level of critical thinking in the control and experimental groups

Level of formation	Establishment experiment				Formative experiment				Dynamics	
	Control group		Experimental group		Control group		Experimental group		Control group	Experimental group
	Persons	%	Persons	%	Persons	%	Persons	%		
Cognitive Criterion										
Critical (Intuitive)	6	5,04%	10	7,58%	5	4,20%	8	6,06%	-0,84%	-1,52%
Acceptable (Reproductive)	31	26,05%	29	21,97%	30	25,21%	16	12,12%	-0,84%	-9,85%
Sufficient (Productive)	65	54,62%	74	56,06%	67	56,30%	79	59,85%	1,68%	3,79%
High (Heuristic)	17	14,29%	19	14,39%	17	14,29%	29	21,97%	0,00%	7,58%
Motivational-Activity Criterion										
Critical (Intuitive)	17	14,29%	22	16,67%	16	13,45%	12	9,09%	-0,84%	-7,58%
Acceptable (Reproductive)	45	37,82%	39	29,55%	45	37,82%	31	23,48%	0,00%	-6,06%
Sufficient (Productive)	43	36,13%	57	43,18%	43	36,13%	60	45,45%	0,00%	2,27%
High (Heuristic)	14	11,76%	14	10,61%	15	12,61%	29	21,97%	0,84%	11,36%
Analytical-Reflective Criterion										
Critical (Intuitive)	17	14,29%	12	9,09%	15	12,61%	10	7,58%	-1,68%	-1,52%
Acceptable (Reproductive)	42	35,29%	41	31,06%	43	36,13%	30	22,73%	0,84%	-8,33%
Sufficient (Productive)	44	36,97%	62	46,97%	45	37,82%	70	53,03%	0,84%	6,06%
High (Heuristic)	16	13,45%	17	12,88%	16	13,45%	22	16,67%	0,00%	3,79%

The formative stage of the pedagogical experiment was carried out during February 2025 – October 2025. The purpose of this stage was to evaluate the efficacy of the identified pedagogical conditions and the model of professional competence development for future social workers in the context of their internship.

During the formative stage of the pedagogical experiment, the subsequent objectives were pursued: cultivating the capacity for critical thought to resist falsehoods and the manipulation inherent in synthetically generated media by integrating instruction rooted in the methodology we formulated within the group undergoing the trial; simultaneously, establishing the criteria and levels of critical thinking abilities across both the comparison and control and experimental groups, measured against established metrics.

In this formative stage of the pedagogical experiment, those participants in the control group received no specific instruction, whereas the subjects in the experimental group benefited from training explicitly following the procedure we devised. This procedure entailed putting into practice our self-developed approach aimed at fostering critical prowess to effectively challenge misinformation and the deceptive handling of media fabricated by artificial means.

Results gleaned from the formative stage, shaping phase of the trial allowed for a head-to-head comparison concerning the degree of critical thought demonstrably present in those subjects designated as the control and experimental groups.

Mathematical and statistical methods are employed in the field of pedagogy to process data and establish quantitative relationships between the phenomena under study. These methods facilitate the evaluation of experimental outcomes, enhance the reliability of conclusions, and provide a foundation for theoretical generalisations (Obilor and Amadi, 2018).

The primary hypothesis (H_0) posited that the effectiveness of the implementation of the developed methodology of critical thinking in counteracting misinformation and the manipulation of artificially reproduced media content of the control and experimental groups, as evaluated by each criterion, did not exhibit any significant differences.

An alternative hypothesis is H_1: The effectiveness of the implementation of the developed methodology of critical thinking to counteract disinformation and the manipulation of artificially reproduced media content differs significantly between the control and experimental groups with respect to each criterion.

In order to determine which of the hypotheses (main or alternative) should be accepted, the following criterion was employed χ^2 – a statistical criterion (Pearson's test) is suitable for analysing data measured on an ordinal scale. A statistical analysis of the results of the observations (indicators of the experimental and control groups) indicates that the empirical value of criterion χ^2_{emp}, the result was then compared with the known value (which was provided in the table of critical values χ^2_a) the reference number represents the pivotal value of the criterion χ^2_{kr} with a given probability of error (level of significance). In our study, we selected an error probability level of 0.05, which signifies that a 5% possibility of error is permitted. This implies that the result is 95% reliable. The critical value of the statistical criterion χ^2_{kr} for 4 grading levels (L=4) according to the criteria table χ^2_{kr}=7,815. Empirical value χ^2 criterion is calculated by the formula 3:

$$\chi^2_{emp} = N \cdot M \sum_{i=1}^{L} \frac{\left(\frac{n_i}{N} - \frac{m_i}{M}\right)^2}{n_i + m_i}, \quad (3)$$

where N – is the total number of students in the experimental group, M – is the total number of respondents in the control group, n_i is the number of respondents in the experimental group with the corresponding grade level; m_i is the number of respondents in the control group with the corresponding grade level; L – is the number of grade levels.

A comparison of the critical and empirical values of the criterion χ^2 reveals the following conclusions: if the empirical value of the criterion χ^2_{emp}, as determined by the researcher, is less than or equal to the critical χ^2_{kr}, then the null hypothesis is accepted with a probability of 95%. In the event that the empirical value of the criterion χ^2 is greater than the critical χ^2_{kr}, the null hypothesis is rejected and an alternative hypothesis is accepted and the alternative hypothesis is accepted, and it is considered that the qualitative characteristics of students in the experimental and control groups are different with 95% confidence. The indicators of the level of critical thinking formation according to the cognitive, motivational-activity, and analytical-reflective criteria were subjected to statistical processing. This was carried out by calculating the obtained statistical data using the Pearson method. For this purpose, the obtained results and the results of calculations were systematised in Table 4.

The calculated value of χ^2_{emp} for each criterion at the establishment and formative stages is compared χ^2 with the critical value according to the table at an error of 0,05 (χ^2_{kr}=7,815). The results of this comparison are then used to draw a conclusion about the acceptance or rejection of the null or alternative hypotheses at this level of significance.

Discussion. In order to ascertain the efficacy of the methodology of critical thinking developed to counteract disinformation and the manipulation of artificially reproduced media content, a number of criteria were identified. These were categorised into distinct groups: cognitive, motivational-activity and analytical-reflective. The indicators that correspond to each of these groups and the levels of critical thinking were then determined. To determine the effectiveness of the developed methodology of critical thinking to counteract disinformation and manipulation of artificially reproduced media content, the following criteria were identified: cognitive, motivational-activity and analytical-reflective criterion. The indicators that meet each criterion and the levels of critical thinking (critical (intuitive), acceptable (reproductive), sufficient (productive) and high (heuristic)) are identified.

Table 4

Calculation of the level of critical thinking formation according to the defined criteria by the Pearson method

Criterion	Stage	Level of criterion formation	Quantity indicators		$\frac{n_i}{N}$	$\frac{m_i}{M}$	$\left(\frac{n_i}{N}-\frac{m_i}{M}\right)$	$\frac{\left(\frac{n_i}{N}-\frac{m_i}{M}\right)^2}{n_i+m_i}$	χ^2_{emp}
			X_i	Y_i					
Cognitive	The establishment	Critical (Intuitive)	6	10	0,05	0,08	-0,025337	0,000040	1,090129 $\chi^2_{emp} < \chi^2_{kr}$ H_0
		Acceptable (Reproductive)	31	29	0,26	0,22	0,040807	0,000028	
		Sufficient (Productive)	65	74	0,55	0,56	-0,014388	0,000001	
		High (Heuristic)	17	19	0,14	0,14	-0,001082	0,000000	
	The formative	Critical (Intuitive)	5	8	0,04	0,06	-0,018589	0,000027	8,419191 $\chi^2_{emp} > \chi^2_{kr}$ H_1
		Acceptable (Reproductive)	30	16	0,25	0,12	0,130889	0,000372	
		Sufficient (Productive)	67	79	0,56	0,60	-0,035460	0,000009	
		High (Heuristic)	17	29	0,14	0,22	-0,076840	0,000128	
Motivational-Activity	The establishment	Critical (Intuitive)	17	22	0,14	0,17	-0,023810	0,000015	2,362628 $\chi^2_{emp} < \chi^2_{kr}$ H_0
		Acceptable (Reproductive)	45	39	0,38	0,30	0,082697	0,000081	
		Sufficient (Productive)	43	57	0,36	0,43	-0,070474	0,000050	
		High (Heuristic)	14	14	0,12	0,11	0,011586	0,000005	
	The formative	Critical (Intuitive)	16	12	0,13	0,09	0,043545	0,000068	8,379910 $\chi^2_{emp} > \chi^2_{kr}$ H_1
		Acceptable (Reproductive)	45	31	0,38	0,26	0,117647	0,000182	
		Sufficient (Productive)	43	60	0,36	0,45	-0,093201	0,000084	
		High (Heuristic)	15	29	0,13	0,22	-0,093647	0,000199	
Analytical-Reflective	The statement	Critical (Intuitive)	17	12	0,14	0,09	0,051948	0,000093	3,296560 $\chi^2_{emp} < \chi^2_{kr}$ H_0
		Acceptable (Reproductive)	42	41	0,35	0,31	0,042335	0,000022	
		Sufficient (Productive)	44	62	0,37	0,47	-0,099949	0,000094	
		High (Heuristic)	16	17	0,13	0,13	0,005666	0,000001	
	The formative	Critical (Intuitive)	15	10	0,13	0,08	0,050293	0,000101	9,048184 $\chi^2_{emp} > \chi^2_{kr}$ H_1
		Acceptable (Reproductive)	43	30	0,36	0,23	0,134072	0,000246	
		Sufficient (Productive)	45	70	0,38	0,53	-0,152152	0,000201	
		High (Heuristic)	16	22	0,13	0,17	-0,032213	0,000027	

The value of the criterion χ^2 provides sufficient grounds to state the rejection of the null hypothesis.The reliability of the differences in the characteristics of the experimental and control groups after the pedagogical experiment is 95%. This indicates that it can be concluded that the application of the proposed pedagogical impact aimed at improving the level of critical thinking to counteract disinformation and manipulation of artificially reproduced media content leads to statistically significant differences in the results at the level of 95% according to Pearson's χ^2 criterion. This analysis indicates that the experimental group demonstrated positive changes in the formation of professional competence.

The revealed dynamics permit the assertion that the implementation of the developed methodology contributed to an increase in the level of critical thinking of the participants in the experiment in terms of identifying synthetically created or modified content. Consequently, in the process of analysing the results of the experimental study, the correctness of the hypothesis that the level of critical thinking can be increased by applying the developed methodology was confirmed.

Comparative data on the levels of professional competence of future social workers in the control and experimental groups are presented in the graph (Fig. 1).

The implementation of the training programme and the developed methodology resulted in an increase in the indicators of critical thinking at the high (heuristic) level of over 8% in the experimental group, while the indicators of the critical (intuitive) level exhibited a decrease. The decrease in the acceptable (reproductive) and sufficient (productive) levels was not significant, as the shift in the

increase in the high (heuristic) and critical (intuitive) levels offset this. The analysis of the measurement results using descriptive statistics for each of the criteria demonstrated a positive change in the experimental group. The statistical significance of the difference between the indicators of the control and experimental groups was determined using Pearson's statistical test.

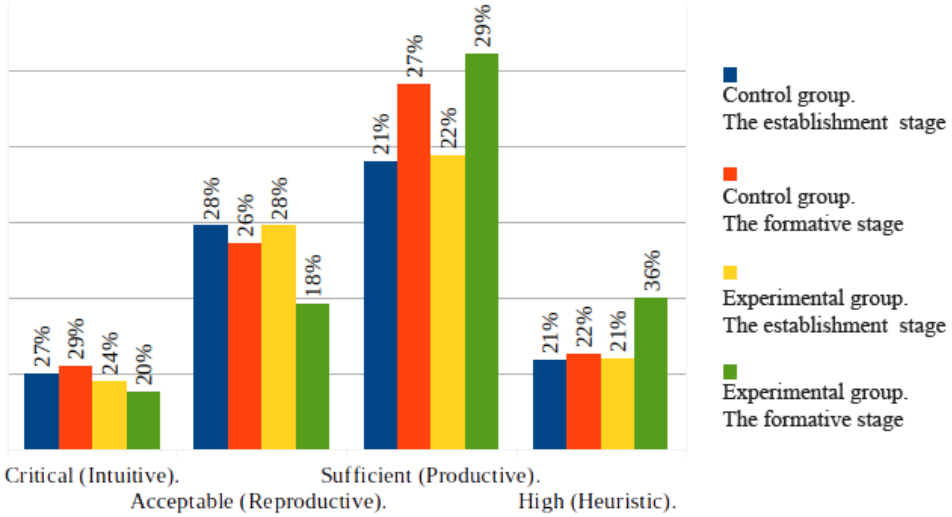


Fig. 1. Comparison of the dynamics of changes in the level of critical thinking of the control and experimental groups

The results of the analysis of experimental data confirmed a statistically significant difference (at the level of significance of 0,05) in the indicators of the criteria of critical thinking formation of the control and experimental groups. The results of the experimental work provide evidence that the methodology of critical thinking to counteract disinformation and manipulation of artificially reproduced media content and its pedagogical support are effective.

Conclusion. During the formative stage of the pedagogical experiment, a system of criteria, indicators, and levels for assessing critical thinking in recognising synthetically generated or altered media content was designed, and the baseline level of these skills was established. At this stage, participants in the experimental group were trained using the newly developed methodology aimed at strengthening their ability to resist disinformation and manipulation associated with artificially produced media content. The training process incorporated several research procedures, including intermediate assessments, questionnaires, and testing.

The control stage focused on determining the final effectiveness of the proposed methodology. This was accomplished by comparing the outcomes of the experimental and control groups, which made it possible to verify or reject the initial hypothesis. Statistical processing further ensured an evaluation of the reliability and validity of the collected data. In addition, the overall effectiveness of the pilot study was examined using final tests, questionnaires, qualitative and quantitative analyses of learning outcomes, and mathematical statistics.

A general overview of the experimental results shows that, at the beginning of the study, the distribution of respondents across the critical (intuitive), acceptable (reproductive), sufficient (productive) and high (heuristic) levels of critical thinking–based on cognitive, motivational-activity, and analytical-reflective criteria–was similar in both the control and experimental groups. However, the post-experiment findings demonstrate a clear improvement among participants in the experimental group. These positive changes confirm the effectiveness of the implemented methodology, as reflected in the increased number of respondents reaching the sufficient (produc-

tive) and high (heuristic) levels of critical thinking in identifying and interpreting synthetically reproduced media content.

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