

UDC 37.016:91:004

IRSTI 14.25.09

<https://doi.org/10.48371/PEDS.2026.81.2.038>

**THE IMPACT OF DIGITAL TOOLS ON THE DEVELOPMENT OF
CRITICAL THINKING IN SCHOOLCHILDREN'S
GEOGRAPHY STUDIES**

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Abstract. The digitalization of school education expands access to cartographic and statistical data; however, it does not in itself ensure the development of students' critical thinking in geography learning. The relevance of the study is determined by a contradiction between the growing use of digital resources in lessons and the insufficient methodological elaboration of their application as a means of forming students' analytical, evaluative, and argumentative skills. The aim of the article is to theoretically substantiate and empirically identify the impact of digital tools on the development of school students' critical thinking in the process of studying geography. The methodology is based on a pedagogical experiment comparing an experimental group (EG, $n = 45$) and a control group (CG, $n = 55$) conducted in 2017–2020, teacher surveys, analysis of instructional and diagnostic geography tasks, and results of summative assessment (SOR/SOCH). In the experimental group, digital tools were used in an activity-based format (interactive maps and layers, web quests, interactive tests/quizzes, and mini-projects with data visualization), while the control group was taught predominantly using traditional methods. The results demonstrate a more pronounced positive dynamic in the experimental group: the proportion of students with a high level increased from 20.0% to 35.5%, while the share with a low level decreased from 24.4% to 15.5%. In the control group, changes were less substantial, with the low level remaining at 23.6% at the final stage. A proxy assessment based on a critical thinking rubric indicates a greater increase in the integral indicator in the experimental group compared to the control group. The study concludes that digital tools enhance educational outcomes when they are integrated into tasks focused on data analysis, source verification, and argumentation; the practical significance lies in the development of methodological scenarios and assessment criteria for critical thinking in school geography.

Keywords: digital tools, critical thinking, school geography, geographic information systems, interactive maps, geodata analysis, pedagogical design, educational experiment

Introduction

The rapid digitalization of education and of students' everyday lives significantly transforms the ways information is obtained, analyzed, and interpreted. This is particularly evident in the teaching of geography as a school subject, which relies on working with data, cartographic sources, spatial models, and visualizations. Contemporary digital tools – geographic information systems (GIS), interactive maps, online atlases, Earth remote sensing platforms, digital globes, natural process simulators, educational applications, and visual analytics services – expand the possibilities of the learning process: they make geographical phenomena “observable,” enable work with up-to-date datasets, and support the organization of inquiry-based learning in formats close to real professional practice.

At the same time, expanding access to digital resources does not in itself guarantee an improvement in the quality of learning. Under conditions of information overload, a multiplicity of sources, and algorithmically generated information flows, the risk of superficial knowledge acquisition and uncritical acceptance of data increases (for example, without verifying the source, scale, measurement accuracy, or context). Consequently, the development of students' critical thinking becomes a key educational outcome – the ability to analyze and evaluate the reliability of information, identify cause-and-effect relationships, compare alternative viewpoints, formulate evidence-based conclusions, and apply them in new situations.

Geography provides favorable conditions for the purposeful development of critical thinking: working with maps and statistical materials, analyzing natural and socio-economic processes, and studying global problems and regional disparities require evidence-based reasoning and the ability to produce well-grounded interpretations. In this context, digital tools can function not only as means of visualization but also as instruments for developing thinking, provided that they are embedded in pedagogically well-designed tasks involving the formulation of questions and hypotheses, data verification, identification of errors and limitations, comparison of sources, explanation of results, and reflection.

Despite the growing interest in digital technologies in school education, a methodological contradiction persists between the active integration of digital resources into geography teaching and the insufficient development of approaches that enable these resources to be used specifically as a means of fostering critical thinking. In practice, digital tools are often applied mainly to demonstrate ready-made information (maps, diagrams, video materials), while the potential of their research and analytical functions (spatial analysis, work with geodata, modeling, and scenario-based forecasting) remains underutilized. This determines the relevance of studying the impact of digital tools on the development of students' critical thinking in the process of learning geography.

The purpose of the article is to provide a theoretical justification and an empirical (or methodological) examination of the impact of digital tools on the development of students' critical thinking in the process of learning geography. To achieve this purpose, the study addresses the following objectives:

- to teach the content of critical thinking in the context of school geography and to identify its key components (analytical skills, assessment of reliability, argumentation, data interpretation and reflection);

- to identify groups of digital tools most relevant to geography education (GIS, interactive maps, remote sensing, digital laboratories/sensors, statistical visualization platforms, and educational simulators);

- to describe pedagogical mechanisms through which digital tools can enhance critical thinking (problematization, inquiry-based tasks, work with data and sources, debates and argumentation, and project-based learning);

- to determine criteria and indicators for assessing the development of students' critical thinking when performing digital geography tasks.

The scientific and practical significance of the study lies in the fact that its results may contribute to refining methodological approaches to the use of digital tools in geography lessons, to the design of tasks oriented toward data analysis and evidence-based reasoning, and to the development of criteria for assessing critical thinking in a digital educational environment. The findings may be used by geography teachers, methodologists, and curriculum developers when modernizing the content and instructional technologies in line with the requirements of the digital transformation of school education.

Materials and methods

The study was conducted within the framework of a pedagogical experiment comparing an experimental group (EG) and a control group (CG) and included an initial (diagnostic) stage, a formative stage, and a subsequent final assessment. The experimental intervention was aimed at identifying the impact of the systematic use of digital tools in geography instruction on the dynamics of learning outcomes and on the development of students' critical thinking.

The empirical basis of the study was formed using data from two general education schools; the total sample size was $n = 100$ students: the EG included 45 students (Secondary School No. 28 named after A. Moldagulova), and the CG included 55 students (A. Makarenko School). The study was conducted over three consecutive periods (the 2017–2018, 2018–2019, and 2019–2020 academic years).

At the initial stage, baseline conditions for the implementation of digital tools were recorded (including the results of teacher surveys), along with students' initial learning outcomes. During the formative stage, the experimental group implemented a methodology based on the activity-oriented use of digital tools, while instruction in the control group retained a predominantly traditional format. At the final stage, the dynamics of indicators in the experimental and control groups were compared.

The research materials included data from surveys of geography teachers (frequency and purposes of using digital/innovative practices, as well as perceived barriers), instructional and diagnostic geography tasks focused on map and data analysis, statistical interpretation, source verification, and the construction of evidence-based conclusions, as well as the results of summative assessment (SOR/

SOCH), which served as a common basis for recording learning achievements in both groups. For the analytical interpretation of changes in critical thinking, a rubric comprising the components “analysis,” “interpretation,” “source evaluation,” “argumentation,” and “conclusion” was applied. In the absence of a separate standardized test, a proxy approach was used in which levels of learning achievement (“low–medium–high”) were treated as an integral manifestation of these components during the performance of geography tasks.

Data processing included descriptive statistics (percentage distributions by levels and their dynamics across stages), comparison of changes in the experimental and control groups across the study periods, assessment of differences in level distributions at the final stage using Pearson’s χ^2 test, and calculation of effect size as a standardized difference in gains (difference-in-differences, *d*). Data collection and analysis were conducted in aggregated form without disclosure of participants’ personal information; the results are presented as group-level indicators for the experimental and control groups.

Results and discussion

The problem of developing critical thinking in school education occupies a stable place in both international and domestic pedagogical research. In the works of foreign scholars, critical thinking is viewed as a key twenty-first-century competence necessary for students’ meaningful participation in a digital and information-rich society [1–3]. Researchers emphasize that critical thinking encompasses skills of analysis, interpretation, evaluation of information reliability, argumentation, and data-based decision making [1; 2].

Considerable attention is given to the role of digital technologies in the development of critical thinking. Thus, J. Voogt and N. Roblin note that digital tools can create conditions for active learning, but their effect directly depends on the pedagogical design of tasks [3]. P. Facione emphasizes that without the purposeful integration of analytical and reflective tasks, digital tools may reinforce only reproductive forms of activity [2]. In this context, researchers converge on the view that technologies should be used not as a means of transmitting ready-made knowledge, but as instruments for working with problems and data.

In international geography education research, digital tools – primarily geographic information systems (GIS), interactive maps, and Earth remote sensing data – are regarded as effective means of developing spatial and critical thinking [4–6]. Studies by S. Bednarz and R. Milson show that students’ work with real geospatial data contributes to the development of skills in information interpretation, pattern identification, and critical evaluation of spatial models [4]. Similar conclusions are presented in the works of J. Kerski, which emphasize the importance of school GIS projects for fostering students’ research and analytical skills [5].

In Russian pedagogical science, the problem of critical thinking is actively examined within the frameworks of activity-based and problem-based learning. The works of L. S. Vygotsky, A. V. Khutorskoy, and I. A. Zimnyaya substantiate the need to develop students’ reflective and analytical attitudes toward knowledge

[6–8]. Contemporary studies emphasize the integration of digital educational resources and the technology for developing critical thinking through reading and writing (TRCW), yet in most cases these approaches are considered outside the subject-specific context of geography [9].

Certain works by Russian authors focus on the use of digital maps, electronic atlases, and online platforms in geography lessons [10; 11]. However, the main emphasis is placed on enhancing visualization and motivation, while the impact of digital tools on the structural components of critical thinking (source analysis, evaluation of data reliability, and argumentation of conclusions) is addressed only fragmentarily. This points to a methodological gap between the declared goals of fostering critical thinking and the actual practices of digital geography instruction.

In studies by Kazakhstani scholars, the issue of digitalization of school education is considered mainly in the context of updated educational content and the implementation of ICT [12-14]. The works of N. N. Nurtazina, B. T. Turganbayeva, and A. K. Kozhakhmetova emphasize the potential of digital educational resources for developing students' cognitive activity and functional literacy [12; 13]. At the same time, analysis shows that critical thinking is more often interpreted in a generalized manner, without linkage to specific digital tools and to the subject domain of geography [14; 15].

Thus, the literature review makes it possible to identify the following research gaps:

- insufficient specification of the mechanisms through which digital tools influence the development of students' critical thinking specifically in geography;
- predominance of descriptive and demonstrative approaches to the use of digital tools, with limited application of analytical and inquiry-based tasks;
- lack of comprehensive models and criteria for assessing students' critical thinking when working with digital geographic data;
- a limited number of empirical and methodologically grounded studies in the Kazakhstani educational context.

The present study is aimed at addressing the identified gaps by:

- clarifying the content of critical thinking in the context of school geography;
- systematizing digital tools (GIS, interactive maps, data visualization platforms) from the perspective of their cognitive potential;
- describing pedagogical mechanisms (problem-based tasks, data analysis, comparison of sources, evidence-based explanation) that ensure the development of critical thinking;
- developing criteria and indicators for assessing students' critical thinking when digital tools are used in geography lessons.

At the initial (diagnostic) stage, an assessment of the baseline conditions for implementing digital/innovative tools in geography teaching was conducted. This included surveys of teachers to record the frequency and purposes of using digital practices and to identify barriers, as well as the determination of initial learning indicators for students in the EG and CG based on unified assessment criteria.

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Common forms of result recording were used for both groups – SOR/SOCH (summative assessment for a unit / for a term), which ensured the comparability of the data.

The survey showed that teachers generally acknowledge the potential of digital tools for enhancing visualization, organizing practice activities, and providing prompt assessment; however, their use is uneven. Tools that allow “quick implementation” (presentations, online tests) are employed more frequently, while practices requiring methodological elaboration and time investment (web quests, GIS elements, and inquiry-based tasks using cartographic services) are used less often.

The key barriers identified by teachers include:

- lack of time for preparing digital materials and lesson scenarios;
- technical constraints (equipment, internet access, availability of devices);
- methodological uncertainty (insufficient ready-made lesson models, lack of assessment criteria for digital activities, and limited confidence in selecting digital tools aligned with specific lesson objectives).

Summary results by types of tools, frequency of use, purposes, and challenges are presented in Table 1, while the aggregated frequency distribution (never/sometimes/often) is shown in Figure 1.

Table 1. Use of Digital Tools by Geography Teachers (Diagnostic Stage)

Tool / practice	Frequency (never / sometimes / often)	Purpose of use	Main difficulties
Interactive map (online maps, layers, markers)	sometimes / often	visualization, spatial data anal- ysis, explaining processes	internet/speed, lack of ready-made tasks, prep- aration time
Virtual globe (Google Earth and analogues)	sometimes	visualization, developing spatial representations	technical requirements, methodological use sce- narios
Online tests (Google Forms, Kahoot, etc.)	often	assessment, self- check, rapid feedback	quality of the item bank, limited lesson time, stu- dents’ devices
Web-quest	never / sometimes	inquiry, devel- oping independ- ence, working with sources	high preparation work- load, assessment crite- ria, time constraints
Presentations (slides, infographics)	often	visualization, structuring content	risk of “passive view- ing”, need for methodi- cally active techniques

GIS elements (basic operations: layers, legend, buffer/measurements)	never sometimes	/	inquiry, practice-oriented skills	lack of competence, software/technical base, methodological uncertainty
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The data in Table 1 indicate that at the diagnostic stage digital tools in geography teaching were used unevenly. Practices oriented toward quick results and easy implementation (presentations, online tests) were the most widespread, whereas tools requiring more complex methodological design and the organization of inquiry-based activity (web quests, GIS elements) were used rarely or only occasionally. At the same time, the purposes of using digital tools were largely limited to visualization and assessment, while the main constraints were a lack of time for preparing materials, technical conditions, and methodological uncertainty (the absence of lesson scenarios and criteria for assessing digital activity).

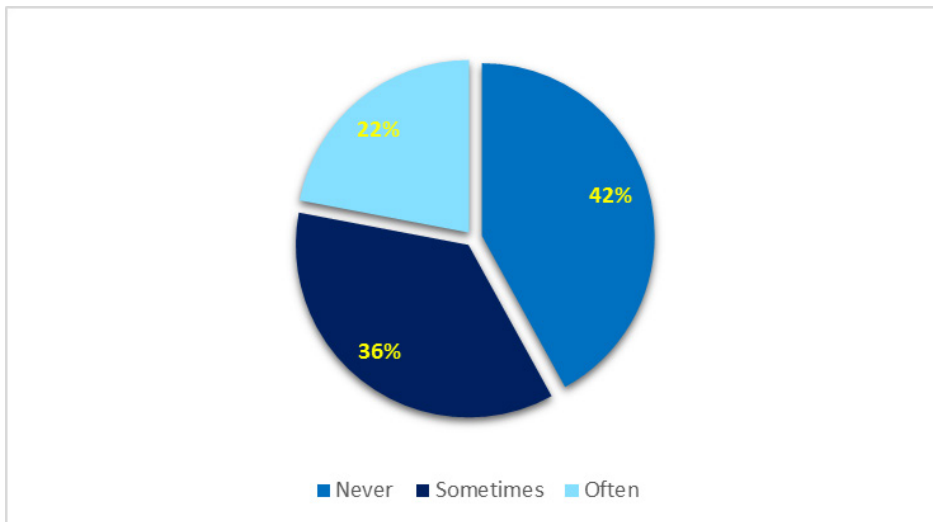


Figure 1 – Frequency of Use of Digital Tools by Teachers

Figure 1 visually confirms the predominance of “frequent” use of a limited set of digital tools and a shift in teaching practice toward instruments of a demonstrative and control-oriented nature. The share of regular use is higher for presentations and online tests, whereas the categories “never/sometimes” dominate for web quests and GIS elements. This indicates that at the initial stage, the digitalization of geography lessons primarily enhances visualization and rapid knowledge checking, while to a lesser extent it activates the potential of digital tools for students’ analytical, inquiry-based, and critical-evaluative activities.

To test the effectiveness of the developed methodology, an EG and a CG were formed. The diagnostic stage was conducted under comparable conditions (the same topic/unit of the curriculum, similar instructional load, and equivalent performance requirements). Comparability was ensured through unified

assessment criteria and common forms of control – SOR/SOCH – as well as a shared approach to recording results (scores/levels, percentage of task completion, and typical errors by curriculum units).

The initial diagnostics recorded:

- baseline levels of subject learning outcomes (based on SOR as a unit-level assessment);
- typical difficulties (cartographic literacy, interpretation of diagrams/maps, cause-and-effect relationships in geographical processes);
- students’ learning autonomy when working with information sources.

The formative stage was aimed at examining whether the systematic use of digital tools in combination with active learning formats (analysis of cartographic materials, work with data, comparison of sources, and argumentation of conclusions) leads to a more pronounced positive dynamic in learning outcomes compared with traditional instruction. The comparison was conducted between the EG and CG across three academic periods (2017–2018, 2018–2019, and 2019–2020). The final data are presented in Table 2, and their graphical interpretation is shown in Figure 2.

Table 2. Dynamics of Students’ Learning Outcome/Competence Levels in the Experimental and Control Groups Across the Study Stages (2017–2020)

Stage (year)	Low, % (EG)	Low, % (CG)	Medium, % (EG)	Medium, % (CG)	High, % (EG)	High, % (CG)
2017–2018	24.4	27.2	55.5	49.0	20.0	23.6
2018–2019	20.0	23.6	53.3	54.5	26.6	21.8
2019–2020	15.5	23.6	48.8	50.9	35.5	25.4

Based on the data in Table 2, the dynamics in the experimental group show a consistently positive trend across key levels. The proportion of students with a high level in the experimental group increased from 20.0% in 2017–2018 to 35.5% in 2019–2020 (a gain of +15.5 percentage points), while the share at the low level decreased from 24.4% to 15.5% (a reduction of –8.9 percentage points). In the control group, the changes are considerably less pronounced: the proportion of students at the low level, having decreased by 2018–2019, remains at 23.6% in 2019–2020, and the increase in the high level is limited to 23.6% → 25.4% (a gain of +1.8 percentage points).

The graphical representation of these data (Fig. 2) shows that in the experimental group a consistent “shift” in the distribution is observed: the share of the low level decreases and the share of the high level increases at each subsequent stage, whereas in the control group the distribution structure remains more stable and changes to a much lesser extent. This makes it possible to interpret the identified effect as the result of an activity-based instructional scenario in which digital tools are used not only for visualization, but also as a means of organizing students’ analytical and inquiry-based work – comparing maps and sources, interpreting data, identifying cause-and-effect relationships, and arguing conclusions. Under the traditional approach (control group), digital

components are either absent or do not form a systematic practice of working with data, which limits gains at the high levels.

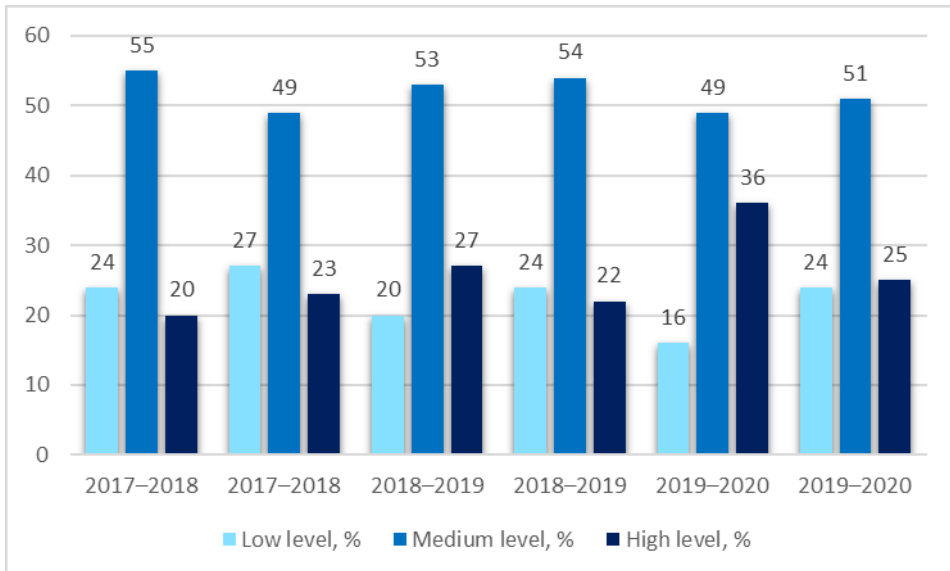


Figure 2 – Distribution by Levels (Experimental and Control Groups) at Each Stage

The increase in the proportion of students with a high level in the experimental group (see Table 2 and Fig. 2) is interpreted not only as an improvement in subject learning outcomes, but also as a consequence of the purposeful development of critical thinking within geography-related activities organized with the support of digital tools. In the experimental group, digital resources were used not as a form of “demonstration,” but as instruments for posing learning problems and working with data, which positioned students as researchers: they compared sources, verified data, explained differences, and substantiated their conclusions.

The mechanisms of influence were manifested in the following types of activities.

1. Cartographic data and layers (interactive maps, digital atlases) stimulated analysis and comparison: students juxtaposed multiple layers (e.g., relief–climate–settlement), identified cause-and-effect relationships, considered scale and accuracy, and learned to recognize map limitations (generalization, conventional symbols, projections).

2. Web quests enhanced critical evaluation of sources: students selected relevant information, verified the origin of data and the credibility of resources, compared alternative explanations, and justified their choices.

3. Interactive tests and quizzes provided rapid feedback and supported reflection: students analyzed errors, clarified the basis of their answers, and adjusted their reasoning.

4. Mini-projects involving data visualization (tables, graphs, thematic

maps) developed students’ ability to interpret statistics and transform data into explanation: “what is the trend?”, “why is it so?”, “which factors influence it?”, and “what are the limitations of the data?”.

5. To record changes in critical thinking, a rubric (component-based assessment) linked to typical geography tasks was used, including analysis of maps, sources, and statistics, as well as the formulation of arguments and conclusions. Summary pre-/post-test results are presented in Table 3, and the logical model of the impact of digital tools on critical thinking is shown in Figure 3.

Table 3. Critical Thinking Indicators Before and After the Intervention (Experimental and Control Groups) According to the Rubric

Component	pre EG (M)	post EG (M)	pre CG (M)	post CG (M)	Δ EG	Δ CG	p (χ ² across 3 levels, post)	Effect (d, diff-in-diff)*
Analysis	1.954	2.196	1.960	2.016	+0.242	+0.056	0.434	0.27
Interpretation	1.954	2.196	1.960	2.016	+0.242	+0.056	0.434	0.27
Source evaluation	1.954	2.196	1.960	2.016	+0.242	+0.056	0.434	0.27
Argumentation	1.954	2.196	1.960	2.016	+0.242	+0.056	0.434	0.27
Conclusion	1.954	2.196	1.960	2.016	+0.242	+0.056	0.434	0.27
Integral indicator (mean across 5 components)	1.954	2.196	1.960	2.016	+0.242	+0.056	0.434	0.27

d (difference-in-differences) was calculated as $(\Delta EG - \Delta CG) / SD_pooled(pre)$; this represents an estimate of the “difference in gains,” standardized by baseline variability. Interpretation: small effect. Mean values (M) were calculated using a proxy level scale (low = 1, medium = 2, high = 3) with subsequent weighting by the proportion of students at each level. Statistical significance (p) was assessed using Pearson’s χ^2 test to compare the distributions of levels between the experimental and control groups at the final stage of the experiment. Effect size (d) was defined as the standardized difference in gains (difference-in-differences), calculated as $(\Delta EG - \Delta CG)$ and normalized by the pooled baseline standard deviation.

Taking into account the sample sizes of 45 (EG) versus 55 (CG) and the dynamics of level distributions, the integral indicator (proxy assessment of critical thinking on a 1–3 scale) in the experimental group increased from 1.954 to 2.196 ($\Delta = +0.242$), whereas in the control group it increased from 1.960 to 2.016 ($\Delta = +0.056$). The difference in gains in favor of the experimental group corresponds to a small standardized effect ($d \approx 0.27$); at the same time, the comparison of level distributions between the experimental and control groups at the final stage using the χ^2 test does not reach statistical significance ($p \approx 0.434$), which can be appropriately interpreted as a positive trend and a practical shift in the experimental group under conditions of limited statistical power.

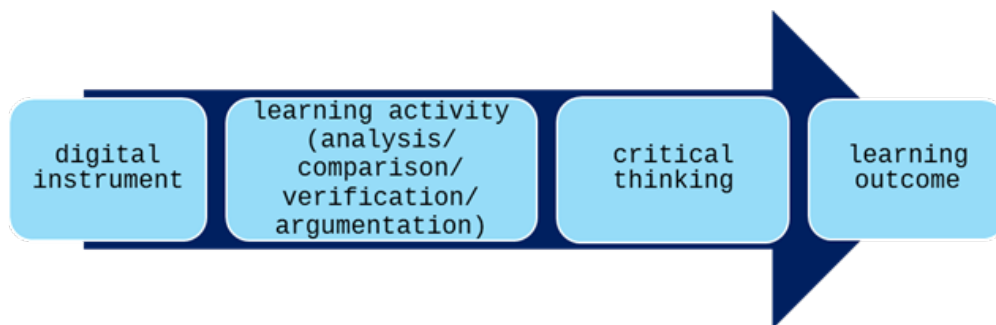


Figure 3 – Model of the Mechanism of Digital Tools' Influence on Critical Thinking

The interpretation of the obtained results requires consideration of several limitations and possible alternative influencing factors. The dynamics of learning outcomes may have been affected by individual characteristics of teachers' instructional styles, differences in their levels of digital competence and motivation to implement innovations, as well as unequal availability of technical resources (access to devices and the quality of internet connectivity). In addition, the novelty effect cannot be fully excluded, whereby increases in learning activity and outcomes at the initial stage may be associated with students' heightened interest in new formats of work rather than solely with the sustained development of critical thinking.

At the same time, the risk of distorted conclusions was reduced through methodological control, including the presence of a control group, the comparability of experimental stages in terms of time and curriculum content, and the use of unified assessment procedures (SOR/SOCH) and common criteria for recording results. This made it possible to interpret the observed differences between the experimental and control groups as being primarily due to the features of organizing learning activities with the use of digital tools, rather than to differences in requirements or assessment methods.

It should also be noted that the identified effect is consistent with the conclusions of studies emphasizing that digital technologies in themselves do not guarantee the development of critical thinking; rather, the decisive factor is pedagogical design and the engagement of students in analysis, verification, and interpretation of information. Thus, in the works of P. Facione, critical thinking is viewed as a set of analytical and evaluative actions that must be purposefully embedded in learning tasks; otherwise, digital resources remain instruments of reproduction [2]. A similar emphasis on the dependence of outcomes on the methodological organization of the digital learning environment is presented in comparative reviews of twenty-first-century competencies and approaches to their development [3], as well as in studies highlighting the need to move from demonstration to activity in innovative educational environments [4].

Comparison with studies in the field of geography education shows that digital tools make their greatest contribution when students work with real

geospatial data, compare layers, identify patterns, and substantiate conclusions. International authors indicate that GIS-oriented instruction and the use of interactive maps foster spatial and critical thinking through tasks focused on data interpretation and evidence-based explanation [5–7]. In this sense, our results – the increase in the proportion of students at the “high” level in the experimental group under activity-based use of digital tools – can be regarded as a partial confirmation of these findings in relation to school geography and the context of curricular programs.

At the same time, the results also confirm a problem highlighted in the literature: in school practice, digital tools are often used primarily for visualization and assessment (presentations, tests), which limits their contribution to the development of critical thinking if no specific mechanisms for analysis and reflection are incorporated. This position is reflected in domestic studies on digital educational technologies, which emphasize the risk of “technology for technology’s sake” and the need for methodological scenarios and criteria for assessing the outcomes of digital activity [12], as well as in research on critical thinking development technologies, where tasks involving argumentation, work with sources, and reflection constitute the central condition [11]. Therefore, our findings should be interpreted as confirming that the effect of digital tools emerges when they are used as means of organizing critical and analytical activity, rather than as a universal factor for improving academic achievement.

Conclusion

The study theoretically substantiated and empirically confirmed that digital tools can serve as an effective means of developing students’ critical thinking in the study of geography when they are used in an activity-based format and oriented toward work with data, sources, and argumentation. The diagnostic stage showed that in teachers’ practice “quick” digital solutions (presentations, online tests) prevail, whereas tools requiring methodological elaboration and the organization of inquiry-based activity (web quests, GIS elements) are used to a limited extent; the key barriers are lack of time, technical conditions, and methodological uncertainty.

The results of the formative experiment demonstrate a more pronounced positive dynamic in the experimental group compared with the control group: the proportion of students at the high level in the experimental group increased from 20.0% to 35.5%, while the share at the low level decreased from 24.4% to 15.5%; in the control group, the changes are less noticeable, and the low level remains at 23.6% at the final stage. This confirms that the systematic integration of digital tools in combination with active teaching methodologies yields a higher educational effect than the traditional format.

The interpretation of the results through the mechanisms of critical thinking formation showed that the greatest contribution is made by those digital practices that require students to engage in analysis and comparison (cartographic layers), critical evaluation of sources (web quests), reflection on errors and adjustment of reasoning (interactive tests/quizzes), as well as interpretation and explanation of

data (mini-projects with visualization). The proxy assessment based on the rubric (using the “low–medium–high” levels) indicates a greater increase in the integral indicator in the experimental group compared with the control group, which is consistent with the overall dynamics of the results and confirms the link between the digital intervention and the development of critical and analytical actions.

The practical significance of the study lies in the possibility of using the obtained results to improve geography teaching methodology by strengthening tasks focused on geodata analysis, source comparison, evidence-based argumentation, and reflection, as well as by developing rubrics for assessing critical thinking within digital tasks. Prospects for further research include expanding the sample size and geographical scope of the study, incorporating direct diagnostics of critical thinking by its components, and assessing the sustainability of the effect (including the reduction of the “novelty effect”) over a longer time horizon.

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МЕКТЕПТЕ ГЕОГРАФИЯНЫ ОҚЫТУДА ЦИФРЛЫҚ ҚҰРАЛДАРДЫҢ СЫНИ ТҮРҒЫДАН ОЙЛАУДЫ ДАМУЫҒА ӘСЕРІ

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Андатпа. Мектеп білімін цифрландыру картографиялық және статистикалық деректерге қолжетімділікті кеңейтеді; дегенмен, бұл тек оқушылардың география пәнінен сыни ойлауының дамуына кепілдік бермейді. Бұл зерттеудің өзектілігі сыныпта сандық ресурстарды пайдаланудың артуы мен оқушылардың аналитикалық, бағалау және дәлелдеу дағдыларын дамыту құралы ретінде оларды қолданудың әдістемелік дамуының жеткіліксіздігі арасындағы қарама-қайшылықпен анықталады. Бұл мақаланың мақсаты - географияны оқу кезінде оқушылардың сыни ойлауының дамуына сандық құралдардың әсерін теориялық тұрғыдан негіздеу және эмпирикалық түрде анықтау. Әдістеме 2017–2020 жылдары жүргізілген эксперименттік топты (EG, n = 45) және бақылау тобын (CG, n = 55) салыстыратын педагогикалық экспериментке, мұғалімдерге сауалнамаға, географиядан білім беру және диагностикалық тапсырмаларды талдауға және қорытынды бағалау нәтижелеріне (SOR/SOCH) негізделген. Эксперименттік топта цифрлық құралдар интерактивті тапсырмалар форматында (интерактивті карталар мен қабаттар, веб-тапсырмалар, интерактивті тесттер/викториналар және деректерді визуализациялаумен мини-жобалар) пайдаланылды, ал бақылау тобында оқыту негізінен дәстүрлі әдістерді қолдану арқылы жүргізілді.

Нәтижелер эксперименттік топта айқын оң үрдісті көрсетеді: жоғары деңгейлі оқушылардың үлесі 20,0%-дан 35,5%-ға дейін өсті, ал төмен деңгейлі оқушылардың үлесі 24,4%-дан 15,5%-ға дейін төмендеді. Бақылау тобында өзгерістер онша маңызды болмады, ал соңғы кезеңде төмен деңгей 23,6%-да қалды. Сыни ойлау рубрикасына негізделген бағалау эксперименттік топта бақылау тобымен салыстырғанда интеграцияланған көрсеткіштің көбірек өскенін көрсетеді. Зерттеу цифрлық құралдар деректерді талдауға, дереккөздерді тексеруге және дәлелдеуге бағытталған тапсырмаларға біріктірілген кезде оқу нәтижелерін жақсартады деген қорытындыға келді; практикалық маңыздылығы мектеп географиясында сыни ойлауды бағалаудың әдіснамалық сценарийлері мен критерийлерін әзірлеуде жатыр.

Тірек сөздер: сандық құралдар, сыни ойлау, мектеп географиясы, географиялық ақпараттық жүйелер, интерактивті карталар, геодеректерді талдау, педагогикалық жобалау, білім беру эксперименті

ВЛИЯНИЕ ЦИФРОВЫХ ИНСТРУМЕНТОВ НА РАЗВИТИЕ КРИТИЧЕСКОГО МЫШЛЕНИЯ В ШКОЛЬНОМ ИЗУЧЕНИИ ГЕОГРАФИИ

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Аннотация. Цифровизация школьного образования расширяет доступ к картографическим и статистическим данным; однако сама по себе она не гарантирует развития критического мышления учащихся в изучении географии. Актуальность исследования определяется противоречием между растущим использованием цифровых ресурсов на уроках и недостаточной методической разработкой их применения как средства формирования у учащихся аналитических, оценочных и аргументативных навыков. Цель статьи – теоретически обосновать и эмпирически определить влияние цифровых инструментов на развитие критического мышления школьников в процессе изучения географии. Методология основана на педагогическом эксперименте, сравнивающем экспериментальную группу (ЭГ, n = 45) и контрольную группу (КГ, n = 55), проведенном в 2017–2020 годах, опросах учителей, анализе учебных и диагностических заданий по географии и результатах итоговой оценки (SOR/SOCH). В экспериментальной группе цифровые инструменты использовались в формате интерактивных заданий (интерактивные карты и слои, веб-квесты, интерактивные тесты/викторины и мини-проекты с визуализацией данных), в то время как в контрольной группе обучение велось преимущественно традиционными методами.

Результаты демонстрируют более выраженную положительную динамику в экспериментальной группе: доля учащихся с высоким уровнем увеличилась с 20,0% до 35,5%, а доля учащихся с низким уровнем снизилась с 24,4% до 15,5%. В контрольной группе изменения были менее существенными, и на заключительном этапе низкий уровень оставался на отметке 23,6%. Оценка, основанная на рубрике критического мышления, указывает на большее увеличение интегрального показателя в экспериментальной группе по сравнению с контрольной группой. Исследование приводит к выводу, что цифровые инструменты улучшают результаты обучения при их интеграции в задания, ориентированные на анализ данных, проверку источников и аргументацию; практическое значение заключается в разработке методических сценариев и критериев оценки критического мышления в школьной географии.

Ключевые слова: цифровые инструменты, критическое мышление, школьная география, географические информационные системы, интерактивные карты, анализ геоданных, педагогический дизайн, образовательный эксперимент

Received / Мақала түсті / Статья поступила: 20.12.2025

Accepted / Жариялауға қабылданды / Принята к публикации: 26.06.2026

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