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A Systematic Interpretation Of The Principles For Developing Critical And Creative Thinking In Digital Education

Yusupov Muxtorbek Roximovich
Independent Researcher at Gulistan State University,
Lecturer at Chirchiq State Pedagogical University

Abstract. The article examines principles for developing students' critical and creative thinking in digital education as a system of interrelated pedagogical requirements. It distinguishes the functions of a principle, a teaching method, and a digital tool. The discussion addresses information verification, reflective regulation, the integration of divergent and convergent thinking, meaningful collaboration, and the connection between critical analysis and creative activity. Each principle is linked to a learning task and observable student actions. The theoretical analysis leads to recommendations for adapting the principles to disciplinary content and assessing both the learning process and its outcomes.

Keywords: Digital education, pedagogical principle, critical thinking, creative thinking, verification, metacognitive regulation, divergent thinking, collaboration.

Raqamli Ta'limda Tanqidiy Va Ijodiy Fikrlashni Rivojlantirish Tamoyillarining Tizimli Talqini

Yusupov Muxtorbek Roximovich
Guliston davlat universiteti mustaqil izlanuvchisi,
Chirchiq davlat pedagogika universiteti o'qituvchisi

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Annotatsiya. Maqolada raqamli ta’lim sharoitida talabalarning tanqidiy va ijodiy fikrlashini rivojlantirish tamoyillari o‘zaro bog‘liq pedagogik talablar tizimi sifatida tahlil qilingan. Tamoyil, metod va raqamli vositaning vazifalari farqlanib, axborotni tekshirish, refleksiv boshqaruv, divergent va konvergent fikrlash birligi, mazmunli hamkorlik hamda kreativ faoliyat uzviyligining metodik mazmuni ochib berilgan. Har bir tamoyilni o‘quv topshirig‘i va kuzatiladigan faoliyat belgisi bilan bog‘lash tavsiya etilgan. Nazariy tahlil asosida tamoyillarni fan xususiyatiga moslashtirish hamda jarayon va mahsulotni birgalikda baholash yo‘llari taklif qilingan.

Tayanch so‘zlar: raqamli ta’lim, pedagogik tamoyil, tanqidiy fikrlash, ijodiy fikrlash, verifikatsiya, metakognitiv boshqaruv, divergent fikrlash, hamkorlik.

Аннотация. В статье принципы развития критического и творческого мышления студентов в цифровой образовательной среде рассматриваются как система взаимосвязанных педагогических требований. Разграничиваются функции принципа, метода и цифрового средства. Раскрывается методическое содержание проверки информации, рефлексивного управления, единства дивергентного и конвергентного мышления, содержательного сотрудничества и взаимосвязи критического анализа с творческой деятельностью. Предлагается соотносить каждый принцип с учебным заданием и наблюдаемыми действиями студента. На основе теоретического анализа определяются способы адаптации принципов к предметному содержанию и совместного оценивания процесса и результата.

Ключевые слова: цифровое образование, педагогический принцип, критическое мышление, творческое мышление, верификация, метакогнитивное управление, дивергентное мышление, сотрудничество.

In the educational process, verifying evidence, drawing independent conclusions, and proposing new solutions demonstrate a student’s ability to apply acquired knowledge in practice. Systematically incorporating these actions into digital assignments requires the instructor to ensure alignment

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between the educational content, methods of activity, and assessment criteria. In achieving this alignment, pedagogical principles serve to define the overall direction for designing learning activities.

The structure of a digital assignment clarifies the specific cognitive processes a student must engage in. For instance, a task involving the collection of topic-related data requires the filtering of information, while a task requiring the comparison of opposing viewpoints directs the student to evaluate the reliability of evidence and the validity of conclusions. When a requirement to develop an alternative solution is added to such a task, the results of the analysis become the foundation for creative activity. Consequently, to foster critical and creative thinking, it is essential to define both the content of the requirements that guide these assignments and the interrelationships between them. The purpose of this article is to clarify the systematic relationship between the principles for developing critical and creative thinking in digital education, and to substantiate ways to incorporate these principles into learning tasks and assessment. To this end, the study employs conceptual analysis, a comparison of scholarly perspectives, and methodological modeling. It examines literature concerning critical thinking, metacognitive control, the generation of creative ideas, and the educational application of generative artificial intelligence. The five proposed principles represent a theoretical synthesis of these perspectives; their practical effectiveness, however, requires further empirical investigation.

A pedagogical principle represents a guiding requirement to be followed when organizing learning activities. A method defines the procedure for implementing this requirement within a specific task, while a digital tool serves to facilitate the execution of the activity. For instance, the requirement to verify information based on evidence can be implemented through the method of comparative analysis of sources, utilizing digital libraries and shared collaborative documents. In this framework, each element fulfills a distinct function: the principle directs the activity, the method establishes the sequence of actions, and the tool enables their execution.

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Such a distinction facilitates the selection of digital tools that are well-aligned with specific pedagogical objectives. When evaluating the capabilities of a program or platform, an instructor determines which cognitive processes a student engages in while using it. For instance, a shared electronic document can be utilized to record evidence, provide commentary on proposals, and justify a final decision. The methodological value of a tool is defined by how effectively it facilitates the completion of a learning task.

In this approach, the principle of critically verifying digital information plays a central role. It requires examining the origin of a source, the quality of the evidence, and the validity of the conclusions drawn. Beyond identifying the author and the date of publication, the student must assess how the information was obtained, whether it is corroborated by other independent sources, and how relevant it is to the task at hand. Consequently, the decision to utilize the information is based on the findings of this verification process.

The concepts of analysis, evaluation, inference, and explanation—as outlined in the report by P. Facione—form the theoretical foundation for this activity. In practical application, the student explains precisely which idea a piece of evidence supports, as well as the limitations that prevent it from being generalized further. For example, before applying results obtained from a specific group to the activities of all students, one must examine the research conditions and the scope of the conclusions. In this way, the reliability of a source and the justification for its use are considered in relation to one another.

The process of verifying information is guided by the principle of reflexive-metacognitive activity. This principle entails that students plan their own activities, monitor the strategies they employ, and adjust them as necessary. J. Flavell's perspectives on metacognitive knowledge and the regulation of cognitive processes provide a basis for explaining this mechanism. As part of a higher education assignment, students are expected to explain why they chose a particular source, identify any difficulties they encountered during the process, and describe how they overcame those challenges.

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Short, precise questions can be used to facilitate reflective activity. Questions such as "Which piece of evidence changed my initial conclusion?", "What information did my search method fail to uncover?", and "Why did I change my subsequent course of action?" are designed to analyze the thinking process. A student's response should highlight the action taken, the difficulty encountered, and the adjustment made. Such records provide material for tracking changes in the approach to a task.

When analysis and reflection are linked to the generation of alternative ideas, the principle of integrating divergent and convergent thinking comes into play. Divergent inquiry involves developing qualitatively different approaches to solving a problem, while convergent selection entails comparing these options based on specific criteria. The OECD's conceptual framework for creative thinking highlights the interconnectedness of generating diverse ideas, creating original proposals, and refining those ideas. This overarching logic can be applied to the design of higher education assignments, with assessment criteria tailored to the students' level of preparation and the specific subject matter.

In accordance with this principle, the assignment should clearly define, in advance, the nature of the distinctions between the various options. Pedagogical solutions may differ in terms of their operational procedures, the roles of the participants, or the specific cognitive processes required. When selecting these solutions, factors such as alignment with learning objectives, sound rationale, innovation, and feasibility are taken into account. Students are expected to explain both the advantages and the limitations of their chosen approach; thus, the generation and selection of ideas become an interconnected process.

The principle of digital interactivity and collaboration plays a crucial role when comparing alternative options. This principle entails that participants engage meaningfully with one another's ideas. A student's contribution might manifest through justifying a proposal, presenting counterarguments, asking clarifying questions, or refining another person's idea. Consequently, collaborative tasks

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are structured to include individual preparation, group discussion, and the documentation of the reasoning behind a collective decision.

Comments and discussion threads within an electronic document serve to illustrate this process. For instance, a student might identify an ambiguous instruction in a group member's proposal and suggest rephrasing it to make it clearer for the end user. In such cases, assessment focuses on how the feedback provided influenced the final solution. Retaining individual comments alongside the group product makes it possible to analyze each participant's contribution.

Integrating the aforementioned requirements into a single activity is achieved through the principle of continuity between critical analysis and creative work. Students examine evidence to generate an idea; as they develop the project, they identify new questions and seek out additional information. Feedback may lead to the refinement of selection criteria or modifications to specific parts of the product. Consequently, the structure of the assignment allows for revisiting previous steps and revising the outcome.

The combined application of these principles can be illustrated through a methodological task assigned to students in the field of pedagogy. Students are tasked with creating a digital assignment designed to support learners in comprehending a literary text. First, the learners' age, the objectives of the lesson, and the available technical resources are determined. Next, sources related to the chosen pedagogical method are reviewed, and the evidence to be used in the project is identified. Based on this, options are developed—such as explaining the causes of events, discussing a character's decisions, or retelling the text from a different perspective. The options are compared based on their appropriateness, age-appropriateness, and ease of implementation. Group members ask questions about any unclear aspects of the selected task, and the author then refines the product based on this feedback. For instance, if it is determined that a task merely requires recalling an event, a requirement is added for the student to justify a character's decision using evidence from the text. The student then explains the reason for this change. This scenario serves

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as an example illustrating the methodological application of the principles; it does not represent the results of an empirical trial.

When utilizing artificial intelligence, its suggestions are incorporated into the process of verifying information, comparing options, and making informed choices. UNESCO's guidance on generative AI emphasizes linking its educational use to human oversight and pedagogical objectives. Accordingly, students should demonstrate which suggestions they accepted, how they verified the underlying evidence, and what modifications they applied. This approach clarifies the role of the AI tool versus the student's independent decision-making.

Assessment of these principles should be based on observable evidence. Verification involves examining the link between a claim and its original source; metacognitive activity entails explaining the rationale behind any strategic shifts; and divergent exploration focuses on the substantive differences between various options. In collaborative work, the influence of individual reasoning on the final collective solution is evaluated, while in iterative processes, the focus is on the reasoned changes made between the initial and revised versions of the work. Students are briefed on these criteria before the assignment begins.

For assessment purposes, the final output, a brief reflective commentary, and notes from discussions are analyzed collectively. The version history documents that changes occurred, while the student's commentary clarifies the content and rationale behind those changes. To ensure a consistent interpretation of the criteria, it is recommended to review sample work together with teachers and align assessment decisions.

Thus, the proposed system of principles integrates the verification of information quality, the management of cognitive processes, the generation of alternative solutions, meaningful collaboration, and the refinement of outcomes. Its methodological substance is manifested in the expression of each requirement through specific tasks, student actions, and assessment indicators. Moving forward, it is necessary to test this system across various subjects, refine

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the criteria, and monitor changes in student performance over the course of several assignments.

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