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A Pedagogical Mechanism Facilitating the Transition from Critical Analysis to the Creation of Creative Solutions Among Students in A Digital Educational Environment

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Abstract
The article examines how university students can be supported in transforming the results of critical analysis into an evidence-informed creative solution in a digital learning environment. This process is described through a pedagogical mechanism comprising problem clarification, information retrieval and verification, comparative evaluation of evidence, generation of alternative ideas, solution design, and reflective refinement. Student actions, intermediate outcomes, and criteria for progression are specified for each stage. The roles of adaptive instructional support, digital collaboration, and electronic portfolios in connecting the stages are explained. The proposed mechanism is theoretical and methodological; empirical evaluation of its effectiveness is identified as a task for future research.

Keywords: Digital learning environment, critical analysis, creative thinking, information verification, argumentation, alternative idea, creative solution, adaptive support, reflective assessment.

INTRODUCTION

RAQAMLI TA’LIM MUHITIDA TALABALARNING TANQIDIY TAHLILDAN KREATIV YECHIM YARATISHGA O‘TISHINI TA’MINLOVCHI PEDAGOGIK MEXANIZM

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Annotatsiya
Maqolada raqamli ta’lim muhitida talabalarning tanqidiy tahlil natijalarini asoslangan kreativ yechimga aylantirish faoliyatini tashkil etish masalasi yoritilgan. Mazkur jarayon muammoni aniqlashtirish, axborotni izlash va tekshirish, dalillarni qiyosiy baholash, muqobil g‘oyalarni yaratish, yechimni loyihalash hamda refleksiv takomillashtirishdan iborat pedagogik mexanizm orqali tavsiflangan. Har bir bosqichda talaba bajaradigan harakatlar, olinadigan oraliq natijalar va keyingi faoliyatga o‘tish mezonlari belgilangan. Adaptiv pedagogik yordam, raqamli hamkorlik va elektron portfolioning ushbu bosqichlarni bog‘lashdagi vazifalari ochib berilgan. Taklif etilgan mexanizm nazariy-metodik xususiyatga ega bo‘lib, uning samaradorligini empirik tekshirish istiqboldagi tadqiqot vazifasi sifatida ko‘rsatilgan.

Tayanch so‘zlar: raqamli ta’lim muhiti, tanqidiy tahlil, ijodiy fikrlash, axborot verifikatsiyasi, dalillash, muqobil g‘oya, kreativ yechim, adaptiv yordam, refleksiv baholash.

Аннотация

В статье рассматривается организация деятельности студентов по преобразованию результатов критического анализа в обоснованное творческое решение в цифровой образовательной среде. Этот процесс раскрывается через педагогический механизм, включающий уточнение проблемы, поиск и проверку информации, сравнительную оценку доказательств, генерацию альтернативных идей, проектирование решения и его рефлексивное совершенствование. Для каждого этапа определены действия студентов, промежуточные результаты и критерии перехода к последующей деятельности. Раскрыты функции адаптивной педагогической поддержки, цифрового сотрудничества и электронного портфолио в обеспечении взаимосвязи этапов. Предложенный механизм имеет теоретико-методический характер; эмпирическая проверка его эффективности обозначена как задача дальнейшего исследования.

Ключевые слова: цифровая образовательная среда, критический анализ, творческое мышление, верификация информации, аргументация, альтернативная идея, творческое решение, адаптивная поддержка, рефлексивное оценивание.

In higher education, a student’s independent thinking is manifested in their ability to identify an academic problem, substantiate their decisions with evidence, and develop new solutions tailored to specific circumstances. Ensuring the interconnectedness of these processes is of particular methodological importance when designing digital assignments. Students must be able to verify the information they find, determine the scope of any conclusions drawn from it, and utilize the results of their analysis to generate new ideas. Therefore, when designing learning activities that employ digital tools, it is essential to establish a clear progression: moving from the acquisition of information to its evaluation, and subsequently to the formulation of well-founded solutions.

Several methodological challenges may arise during this process. If a problem is not clearly defined, the search for information can become aimless; furthermore, even information obtained from a reliable source may prove insufficient to substantiate a specific decision. Additionally, if a new idea is not aligned with user needs, available resources, or the requirements of the assignment, the process for its implementation remains unclear. These challenges underscore the need for a pedagogically sound approach to managing the transition between critical analysis and creative activity. In this context, every action taken by a student should establish a meaningful foundation for subsequent activity, while intermediate results must be verified using clear criteria.

From this perspective, the pedagogical mechanism is interpreted in this article as a procedural framework that integrates a student’s cognitive processes, intermediate outcomes, criteria for transitioning between stages, and feedback. Its essence is defined by the tasks a student performs, the methods used to verify the results obtained, and the conditions under which the student may return to previous stages of activity. The objective of this article is to describe a

pedagogical mechanism—within a digital educational environment—that facilitates the transition from critical analysis to the creation of creative solutions, and to develop methodological recommendations for its implementation.

To achieve this goal, the study employs theoretical analysis, a comparison of scholarly perspectives, and pedagogical modeling. Approaches concerning critical thinking, the generation of creative ideas, metacognitive monitoring, and the provision of pedagogical support within problem-based learning are examined in their interconnectedness. P. Facione's report highlights aspects of critical thinking related to interpretation, analysis, evaluation, inference, explanation, and self-regulation. These perspectives provide a theoretical basis for examining a student's response in conjunction with the evidence upon which it is formed.

The OECD's conceptual framework for creative thinking is also significant in explaining the link between critical analysis and creative activity. It interprets the processes of generating, evaluating, and refining ideas as interconnected activities. In this article, this approach is applied to the development of alternative solutions and their subsequent refinement based on established criteria. The tasks and criteria are determined in alignment with the students' professional training and the specific content of the activities being performed.

A student's ability to monitor and adjust their own work can be explained through J. Flavell's concepts of metacognitive knowledge and cognitive control. This theoretical framework helps identify the strategies a student employed, the challenges they encountered, and the reasons behind any changes made to their chosen approach. Furthermore, analyses concerning pedagogical support within problem-based and inquiry-based learning highlight the importance of tailoring assistance to the student's specific needs during a given activity. Synthesizing these perspectives, a mechanism is proposed that encompasses problem clarification, information verification, comparison of evidence, generation of alternative ideas, solution design, and reflective refinement. The scenarios presented below serve as methodological examples to illustrate this mechanism and do not represent the results of empirical testing.

In the proposed mechanism, critical analysis is directed toward defining the nature of a problem, verifying assumptions, and identifying the evidence necessary for making a decision. Creative activity, meanwhile, involves generating new options—while accounting for identified needs and constraints—and translating them into practical forms. These activities complement each other throughout the task: verified evidence forms the basis for new ideas, while those ideas, in turn, give rise to further questions for investigation. Consequently, the student gains the ability to provide a coherent rationale for their decision and, if necessary, to revise it.

For instance, a student might identify the lack of visible contribution from certain participants in an online discussion as a problem. In such a case, the first step is to determine the criteria used to evaluate participation. Following this, various options are developed—such as reallocating tasks, having participants draft their thoughts in advance, or rotating roles within the discussion. Each option is then evaluated based on how effectively it addresses the identified need. In this way, the general notion of "low participation" is transformed into a task: developing a procedure that requires each student to provide evidence and demonstrate their contribution to a collective decision.

The initial prerequisite for this shift is to define and delimit the problem. Students learn to distinguish between an observed situation, the interpretation applied to it, and its hypothesized cause. It is determined to whom the problem pertains, which activities it involves, and under what conditions it arises. The educator guides the inquiry by asking questions such as: "What specific situation did you observe?", "What indicators can be used to identify the problem?", and "What information is currently missing?" Answering these questions leads to the formulation of a problem statement, an initial hypothesis, and specific questions that highlight the need for further information. Once the problem is defined with sufficient precision to direct subsequent investigation, the process moves on to working with information.

Defining the scope of a problem establishes a foundation for targeted information searching and verification. The student selects keywords relevant to the inquiry, filters sources, and examines the origins of the information contained within them. This process involves noting the author, the purpose of the material, the primary source of the evidence, and its relevance to the task. The repetition of the same idea across multiple websites is not accepted as independent corroboration; instead, it is determined whether such references trace back to a single source or rely on specific, shared pieces of evidence. This activity requires the student to focus on the substantive and evidentiary value of the sources.

When working with information, responses generated by artificial intelligence are also treated as a collection of claims that require verification. The student compares the author, date, source, and conclusions provided in the response against relevant materials. Points that cannot be verified are marked as unconfirmed. The outcome is a list of verified sources, accompanied by brief annotations and a record of any remaining, unresolved questions. If there is insufficient information to substantiate a significant claim, further research is conducted, or the initial question is refined.

The availability of verified information necessitates a separate evaluation of the conclusions drawn from it. Consequently, the subsequent phase focuses on comparing evidence and determining its relevance to a specific decision. The student explains what each piece of evidence substantiates, what conclusions it supports, and which questions it fails to address. During this process, an "evidence map" can be used to distinguish between the primary claim, supporting data, counter-evidence, and unverified assumptions. The connections within this map are justified through the student's own written or oral explanations.

The comparative evaluation of evidence leads to the establishment of criteria to be considered when developing a solution. In the context of an online discussion, for example, such criteria might include documenting individual contributions, providing evidence for every proposal, and articulating the rationale behind the final collective decision. These criteria bridge the gap between analytical findings and creative exploration. If a logical disconnect is identified between a fact and a conclusion, the student either seeks new information or narrows the scope of the conclusion.

Based on the established criteria, the student develops alternative ideas that are substantively distinct from one another. This may involve viewing the problem from the perspectives of various stakeholders, modifying existing operational procedures, or adapting experiences from different contexts. For instance, in an online discussion, various options are proposed to highlight individual contributions—such as documenting a student's initial thoughts

separately, rotating task responsibilities within the group, or having each student provide an individual commentary on the final decision. The substantive differences between these options and their respective approaches to the problem are explained.

Once ideas have been generated, criteria for selecting them are applied. In this framework, relevance to the problem, substantiation, novelty, and feasibility of implementation are proposed as the primary criteria. Students are expected to identify both the advantages and the limitations of their chosen option. This process results in a set of alternative proposals, accompanied by a written rationale for the selection. After explaining how the chosen idea addresses the problem—and how its effectiveness can be verified—the process moves on to the design phase.

During the design process, an idea is refined by defining the actions to be taken, the necessary resources, and the expected outcomes. The student determines who will use the product, how it will function, and the criteria against which it will be evaluated. Depending on the nature of the assignment, the final output may take the form of a methodological scenario, a digital guide, an infographic, an interactive task, or another type of prototype. The digital tool is selected based on the product's intended function; for instance, when designing a process for group decision-making, a shared digital document could be used to record individual opinions, raised objections, and the final decision.

The prototype is then reviewed by group members, who assess the clarity of the usage procedures and instructions, identify any missing components, and point out requirements that are difficult to implement. For example, if the instructions for an online discussion do not clearly specify who should contribute and when, or how a collective decision should be formalized, these aspects are revised. While this type of formative review provides information for improving the product, determining its actual educational effectiveness would require a separate empirical study.

The feedback received serves as a basis for reflective assessment. The student compares the product against the initial objectives and selection criteria, explaining which decisions were supported by evidence, which assumptions shifted, and what adjustments were made. This process is guided by questions such as: "What evidence led me to change my decision?", "Which requirement did the chosen option fail to fully meet?", and "What will I change in the next iteration, and why?" Responses must clearly state the decision made, the underlying data, and the specific changes to be implemented.

Subsequent actions are determined based on the outcomes of this reflective assessment. If information is lacking, the student returns to research and verification; if conclusions do not align with the evidence, they engage in comparative analysis; and if the solution fails to address the identified need, they return to generating alternative ideas. In this way, the stages of the process are interconnected based on the quality of interim results and any challenges encountered. This approach allows the student to articulate both the reasons for maintaining their original ideas and the necessity for making changes.

Adaptive pedagogical support plays a crucial role in ensuring the coherence of these activities. It entails providing assistance tailored specifically to the particular challenges a student faces. A student struggling to verify a source is provided with guiding questions, while one having difficulty with argumentation is tasked with clarifying the connection between a claim and its

supporting evidence. A student who hits a roadblock while generating ideas is encouraged to examine the problem from the perspective of another user. The nature and extent of the support provided are adjusted based on the student's ability to perform the task independently; for instance, one might initially offer guiding questions and a structural template, while later requiring the student to apply the criteria on their own.

Organizing digital collaboration alongside adaptive support also necessitates clear individual accountability. The specific roles of group members and their respective contributions to the final decision must be transparent. Tasks such as verifying sources, comparing evidence, proposing alternatives, and reviewing the project can be distributed among the members. Furthermore, each student is expected to provide an individual explanation of the group's final solution. Consequently, this approach allows for the simultaneous examination of both the collective output and the cognitive processes of the student who contributed to its creation.

The use of artificial intelligence tools is also organized in accordance with this operational framework. These tools may be employed to generate alternative questions, propose initial ideas, or identify ambiguities within the project text. Students are required to document which suggestions they accepted, how they verified them, and what modifications they subsequently made to their proposed solutions. This requirement facilitates a distinct analysis of the influence exerted by the auxiliary tool versus the student's own independent decision-making.

To evaluate these aspects of the process, the creation journey is documented alongside the final product. The problem statement, verified sources, evidence map, alternative ideas, preliminary drafts, and final revisions are compiled into an electronic portfolio. Each item is accompanied by a brief annotation explaining its impact on subsequent decisions—for instance, a student might note why a particular source was excluded or which part of an initial draft was revised based on feedback. In this way, the portfolio reflects not only the work completed but also the evolution of the decisions made.

Suggested assessment criteria include the clarity of the problem definition, the rigor of information verification, the alignment between evidence and conclusions, the substantive diversity of ideas, the feasibility of the proposed solution, and the extent to which revisions are supported by evidence. These criteria are explained to students before an assignment is given. Neither the number of files in an electronic portfolio nor the time spent on the platform is taken as a direct indicator of the quality of thinking. Assessment focuses on the decisions a student makes, the rationale provided for them, and how these decisions are modified based on feedback. To determine the diagnostic potential of these criteria, it is necessary to test them across various assignments and verify the consistency of the evaluators' judgments.

The theoretical and methodological analysis presented indicates that, in a digital learning environment, it is essential to clearly define the connections between problems, evidence, ideas, projects, and reflection to facilitate the transition from critical analysis to the creation of innovative solutions. The proposed pedagogical mechanism structures this process through six stages, including their intermediate outcomes and the criteria for transitioning between them. In this framework, the results of critical analysis serve as a catalyst for creative inquiry; alternative ideas are developed into projects; and feedback on these projects leads to well-founded refinements.



Within this mechanism, adaptive support is designed to provide assistance tailored to the specific challenges a student faces; digital collaboration facilitates the joint discussion of decisions; and the electronic portfolio serves to document changes in the student's work and activities. The effectiveness of the mechanism has not been empirically verified in this article. Future research is intended to refine the stage criteria based on practical tasks, document the extent of pedagogical support provided, and conduct a comparative assessment of changes in students' independent analysis and creative problem-solving activities.

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