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FORMATION OF COGNITIVE FLEXIBILITY AND METACOGNITIVE SKILLS

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Abstract
This article is devoted to the theoretical and methodological foundations of the development of cognitive flexibility and metacognitive skills in the professional training of future teachers. The complexity of the digital educational environment (information overload, hypertext, artificial intelligence integration) is analyzed, and the need for a high level of mental flexibility and effective self-management in these conditions is substantiated. The study proposes specific mechanisms for the formation of these competencies - problem-based learning (PBL), interactive methods using reflective e-portfolios and virtual simulations.

Keywords: Future teachers, Cognitive flexibility, Metacognitive skills, Digital learning environment, PBL, Reflection.

Introduction

Abstract
This article provides a theoretical and methodological basis for the development of cognitive flexibility and metacognitive skills and the process of professional training for the future. Analyziruetsya slojnost tsifrovoy obrazovatelnoy sredy (information peregruzka, hypertext, integration of artificial intelligence) i obosnovyvaetsya neobhodimost vysokogo irovnya umstvennoy adaptivnosti i effektivnogo samoregulirovaniya v etikh usloviyax. V issledovanii predlagayutsya concrete mechanisms for the formation of competence data, including interactive methods with the use of problem-oriented training (PBL), reflexive electronic portfolios and virtual simulations.

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Keywords: Budushchie uchitelya, Cognitive flexibility, Metacognitive habits, Tsifrovaya obrazovatelnaya sreda, POO, Reflection.

Introduction

XXI century education paradigm main change teacher 's knowledge source from the role activity organization provider and cognitive processes manager to the role It is a transition. Digital education environment — infinite information flow , rapid variable technologies and global networks each other intersected complicated system to be, this under the circumstances traditional pedagogical skills enough not. Future teacher in front of standing main task — not only new information to master, perhaps study situations fast when changing thinking direction quickly replace to acquire (cognitive flexibility) and own to study process independent manage acquisition (metacognitive) skills (ability) has is to be .

Uzbekistan In the Republic education system to develop aimed at reforms in the program modern pedagogical technologies current to grow and teacher of the staff competencies improvement priority direction arrived This is defined. under the circumstances digital of the environment students cognitive potential to form the secret of the effect deep to study and this for effective methodologies working exit current scientific problem is considered .

Digital education environment under the circumstances future in the past cognitive flexibility and metacognitive skills development pedagogical - psychological mechanisms and effective methods theoretical justification and practical suggestions working from the exit consists of .

Scientific novelty of the study:

1. of the cognitive flexibility model based on an analysis of the impact of digital learning environments on cognitive load .

2. Development of a methodology for using digital tools for reflection and self-assessment in the formation of metacognitive skills .

3. Proposing practical proposals aimed at developing these skills during the professional training of future teachers.

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Future teacher competencies

where the requirements for the education system have changed radically, traditional knowledge and skills that determine the competence of a teacher are not enough. A modern teacher should not only be a transmitter of knowledge, but also a person who manages the educational process, sorts information and is adaptable to constant changes. This requires the future teacher to have **cognitive flexibility** and **metacognitive skills . This chapter** provides a scientific and theoretical justification of the essence, components and role of these concepts in the pedagogical system .

The essence of cognitive flexibility

Cognitive Flexibility is one of the central concepts of modern psychology and cognitive science , and refers to a person's ability **to effectively adapt to different situations, change strategies, and quickly switch from one task to another** . It is part of the Executive Functions and includes the following three main components:

1. Context change : Quickly adapting to new rules and requirements by abandoning an approach or thinking model that was previously successful in solving a problem but is no longer appropriate for the current situation.

2. Approach Switching : Quickly and smoothly switching between different sets of data or different ways of thinking within a problem.

3. Understanding Structure: The ability to analyze complex, ambiguous, or multi-meaning information from different perspectives.

From a pedagogical perspective, cognitive flexibility is vital for teachers . In a digital learning environment, unexpected technical glitches occur during the lesson, students learn at different rates, or the need to quickly switch between different digital tools (platforms, applications) is a constant occurrence. Cognitive flexibility can help teachers cope with these situations **while reducing stress.** allows the teacher to maintain lesson effectiveness.

Cognitive Flexibility Theory, developed by the famous cognitive psychologist R. Spiro, understands the educational process as "a complex and context-dependent process of knowledge processing ." This theory requires the provision of a set of "distributed and interconnected knowledge" to prepare future teachers for complex, non-standard and multidimensional situations .

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Metacognitive skills structure

Metacognitive skills are the ability to **"think about thinking** ." They include a person's knowledge of their own cognitive processes (learning, remembering, paying attention) and their ability to control them. Metacognitive competence consists of two main elements:

A. Cognitive knowledge

This section covers an individual's understanding of their learning styles, strengths and weaknesses, and the demands of the task. It is divided into three sub-components :

- **Declarative knowledge: Knowledge** about oneself (How do I learn?) and about strategies (What strategies are available?).
- **Procedural knowledge:** Knowledge of how to apply strategies and when to use them.
- **Conditional knowledge:** Knowledge about which strategy to use in which context (situation).

B. Regulation of Cognition

This part refers to the actual control and management of the learning process. This is **the regulatory (managing) function** of metacognitive skills , which includes three stages:

1. Planning: Setting goals, choosing learning strategies, allocating time and resources.

2. Monitoring: Continuously checking the effectiveness of one's actions while performing a task , assessing the level of knowledge acquisition.

3. Evaluation: After completing the task , critically analyze the overall results of the learning strategy and draw conclusions for future actions.

a future teacher in digital education. They serve as the basis for him or her to independently master new technologies , determine his or her own professional development trajectory, and constantly self-correct when organizing online lessons.

The role of the future teacher in the system of competencies

modern teacher competencies is often divided into fundamental, professional-pedagogical, socio-personal and digital-technological blocks. Cognitive

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flexibility and metacognitive skills are **"transversal"** competencies that are interconnected with all of these blocks.

Competence Block	Role of Cognitive/Metacognitive Competencies
Professional and pedagogical	**Metacognitive regulation:** Developing individual approaches for students with different learning styles and using reflection in analyzing the lesson process.
Digital-technological	**Cognitive flexibility:** Quickly transitioning to new software or platforms, quickly switching to a backup plan (Plan A/Plan B) in the event of a technological failure.
Socio-personal	**Metacognitive control:** Managing professional stress and "cognitive overload" (information overload), being aware of emotional states and reducing their negative impact on the learning process.

Digital learning environment as a tool for development.

a future teacher, it is necessary to analyze the environment itself. The digital educational environment is not only a set of technical means (computer, Internet), but also a new pedagogical and psychological system that leads to a radical change in the processes of presenting and assimilating information. This environment simultaneously manifests itself as both **a tool that expands cognitive capabilities** and **a challenge that tests mental resources .**

of the digital environment on the learning process.

unique features compared to the traditional learning process , which require a new level of cognitive approach from the teacher:

1. Nonlinearity and Hypertext: Digital information, especially in the form of hypertexts, is organized in a way that requires students to constantly switch between different sources and directions, rather than learning information sequentially from one source . This activates **cognitive flexibility , as** the teacher must teach students to analyze multiple sources at once, find connections between them, and quickly switch their thinking focus.

2. Multimodality: Knowledge is delivered not only through text, but also through various channels such as video, audio, interactive simulations, and infographics. The teacher must be able to process, synthesize, and convey these different types of information to students within the framework of a lesson. This, in turn , increases the need to develop complex cognitive skills, in particular the ability to generalize different information.

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3. Active interactivity: In a digital environment , the learner is not a passive listener, but an active participant. The teacher must constantly respond to chat messages, polls, changes in group work, and real-time questions from students throughout the lesson. This situation dramatically increases the demand **for divided attention** and **rapid decision-making (cognitive flexibility) .**

Artificial intelligence and "big data" as cognitive overload

While artificial intelligence (AI) and big data technologies serve to optimize the educational process, they also create a new and complex **cognitive load** for future teachers .

- **Information overload : The** exponential growth of educational materials on the Internet requires teachers to select, sort, and filter the most relevant, reliable, and curriculum-appropriate information. This process requires a high level of **metacognitive control** (self- assessment and strategy selection).
- **Data-driven decision-making: Modern learning platforms (LMS)** collect large amounts of data about student activity (how much time they spent on which tasks, which questions they made mistakes) . The teacher must be able to read this "Big Data", analyze it and build individual learning trajectories based on it. This requires the development of **analytical cognitive skills .**
- **Adapting to AI and Automation :** Artificial intelligence will take over some functions such as lesson planning, assessment, and feedback. The teacher will need to adapt his role to automated processes, i.e., effectively collaborate with AI, critically evaluate AI-generated content (metacognitive evaluation), and integrate it with human pedagogy (cognitive flexibility). Otherwise, he risks losing his professional relevance.

The need for self-management (metacognitive) in online learning

While in a traditional classroom setting the physical presence of the teacher plays the primary control role in organizing the learning process, in online (distance) learning this control role is partly assigned to the student and the teacher. Therefore, metacognitive skills are a crucial factor for the success of online learning.

1. **Distraction Management: In an online environment (at home or on a personal computer) ,** the number of distractions is significantly higher (social media, household noise). The future teacher needs to master metacognitive strategies (self-motivation, optimization of the learning environment) to

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independently manage his or her own and students' attention in this environment.

2. **Self-Pacing:** Most online courses are delivered asynchronously (not simultaneously), which requires the teacher **to create an individual timetable for mastering the learning material and strictly monitor it. This directly** depends on the development of metacognitive planning and control functions .

3. **Technological Self -Efficacy:** Teachers need to increase their confidence in their technological knowledge (technological self-efficacy). Metacognitive skills strengthen this confidence because teachers can plan for mastering new technology, implement it, and evaluate the final result and draw conclusions for themselves.

Using problem-based learning (PBL) and case study methods in digital format to develop cognitive flexibility

Cognitive flexibility is the ability to adapt to rapidly changing situations in teaching, easily switching between different ideas or strategies. Developing this skill in a digital learning environment requires combining traditional methods with interactive **and dynamic digital tools .**

Problem-Based Learning (PBL)

that encourages students to face real-life or professional problems , and they acquire knowledge by independently searching for information, putting forward hypotheses, and finding solutions. In a digital environment, PBL is implemented as follows:

1. Virtualization of the Problem: Virtual situations are created that resemble real school settings (e.g., in Google Classroom or Moodle). The problem is presented through **audio, video, or simulation programs** rather than a textual statement .

- Example: Students need to deal with a difficult situation, such as an unexpected technical glitch in a Zoom class or a student's sudden drop in motivation during class.

2. Differentiation of Information: Students are presented with a set of resources needed to solve a problem, but these resources contain true **, false, and misleading information** . This forces the student to sort through the different pieces of information (activating cognitive flexibility) to reach a logical conclusion.

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3. **Extensive Case Study (Multi-perspective Approach):** A case study should not have a one-sided solution , but rather present different solutions to a pedagogical problem (psychological, methodological, technological) in a format where they compete with each other. Evaluating these solutions expands the cognitive scope of the student.

Digital interactivity of the case study method

Case studies are effective for cognitive flexibility because they require the student to quickly transfer existing knowledge and skills to a new context.

- **Interactive Cases:** Digital cases are created in tools like H5P or Genially, where each choice the student makes leads to the next development of the situation (the **"Choose Your Own Adventure"** format). If the student makes a wrong decision, the system provides feedback to help analyze their mistake.
- **Virtual School Simulations:** Some higher education institutions have created virtual school classrooms where students have the opportunity to practice classroom management, motivating students, or conducting virtual meetings with parents.

The role of reflection technologies in developing metacognitive skills

Metacognitive skills are the ability of an individual to manage their own learning process (self-planning, monitoring, evaluation). In the context of digital education, where the teacher is forced to constantly change and work independently, metacognitive skills become an integral part of the competence.

Electronic Portfolios (E-Portfolios) and Self- Assessment

collecting and storing student work (lesson plans, practice reports, video lessons), electronic portfolios become a tool **for reflective analysis** .

1. **Reflective Journaling:** At the end of each assignment , the student is required to answer the following questions before submitting them to their portfolio :
   - What did I do? (Planning)
   - How did I do this? (Monitoring)
   - What challenges did I face and how did I overcome them? (Strategic change)
   - How can I do this better next time? (Evaluation and correction)

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2. Video Analysis and Self-Monitoring: Virtual lessons or practical exercises conducted by prospective teachers are recorded in video format. The student later watches his/her lesson and evaluates his/her speech, classroom management, and attitude **"through the eyes of a student."** The opportunity to write time-stamped comments under the video is provided, which deepens metacognitive analysis.

Artificial Intelligence and Analytics Help

Learning Analytics tools play an important role in developing metacognitive skills :

- **Comparison and Self- Measurement:** LMS (Learning Management System) platforms provide students with data on how they are learning (e.g., which topics they are spending the most time on, which assignments they are procrastinating on). Based on this data, the student should consciously change their learning strategies .
- **"Cognitive Tutor" programs:** Artificial intelligence-based programs automatically identify gaps in a student's knowledge and provide them with clear direction (which resource to refer to), which develops their ability to independently plan their learning process.

Simulation games and virtual reality

advanced capabilities of digital learning is the ability to experiment **in a safe and controlled environment . Simulation** games and virtual reality (VR) require maximum cognitive flexibility.

Simulation Games (Gamification)

Gamification elements not only increase motivation, but also develop cognitive flexibility, as games can constantly change rules and goals.

- **Role -Playing Simulation:** Students are placed in virtual scenarios where they take on the roles of various students, parents, or administrators. They are required to use a variety of intellectual and emotional strategies to resolve the situation.
- **Time Management Games :** These games teach the future teacher to perform multiple tasks (e.g., explaining, answering questions, maintaining order) in a limited amount of time, just like in a real lesson.

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Virtual Reality (VR) Technologies

VR creates an immersive experience, which increases cognitive load and increases the need for adaptation.

1. Virtual Classroom Management: In the most advanced teacher training programs, students are taught in a virtual classroom through VR headsets. Here, artificial students exhibit various behaviors (asking difficult questions, being disruptive, distracting). The student must quickly change their style and adapt to the situation.

2. Observational VR: Students can observe real-life lessons taught by experienced teachers through VR as "participant observers." This develops the skills of observing the process and analyzing the methodology involved, as well as metacognitive evaluation.

Conclusion

Developing cognitive flexibility and metacognitive skills of future teachers in a digital learning environment requires the integration of pedagogical innovations with technological solutions. Methods such as problem-based learning, interactive cases, and reflective electronic portfolios regulate the intellectual activity of students. Simulation and VR technologies allow you to test theoretical knowledge in practical situations. This set of approaches prepares future teachers for the complex, rapidly changing requirements of modern education.

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