Learning Processes and Instructional Design with Digital Technologies

COURSE CONTENT:

1. **Learning Theories with Digital Technologies**
    - The concept of added pedagogical value and innovation
    - Mapping learning theories with digital technologies: conditioned responses, unveiling scientific insights, memorization and response to questions, and meaning-making
    - Personalized learning and collective learning
    - Learning through exploration, expression, and hands-on activities
    - Learning and refutability
    - Learning and hands-on activities: production, adaptation, dialogue, and argumentation
    - Meaning-making of key concepts and awareness of complex issues
    - Aspects of the learning process uniquely activated by digital expression tools
    - Computational thinking and programming
2. **Theoretical Frameworks for the Learning Process with Expressive Tools**
    - The U.D.G.S. model, Theory of Instrumental Genesis, Gradual Scientific Literacy, Semiotic Mediation
3. **Design of Expressive Tools and Structures**
    - The concept of transparency and black and white box design
    - The concept of microworlds and examples of microworlds
    - The concept of micro-experiments
    - The concept of scenarios – activity plans
4. **The Concept of Structure Design for Teachers and Students**
    - Secondary development within the framework of computational thinking
    - Learning through design
    - Design models and their adaptation for pedagogical value
    - The educator as a designer of materials and digital structures
    - Teacher’s knowledge, beliefs, and practice in the role of a designer

Detailed Description of Units:

In the **first unit**, an overview of learning theories with digital technologies is provided, highlighting the impact of computational technologies on learning processes, established and emerging theories, and current trends. It is emphasized that computational support for learning is a complex issue with multiple components. Learning does not evolve in a vacuum, nor is it solely dependent on the nature of the content; the student also responds to a variety of factors, and digital environments reshape the overall context. Formalistic thinking alone is not a comprehensive solution.

The **second unit** highlights that the use of specific materials, tools, and symbols profoundly influences both the nature of skills and knowledge students develop and the processes by which they are acquired. Initially, a symbol serves as a social tool used to influence others, and later it becomes a means of self-influence and inner consciousness. Human action is collective and mediated by cultural symbols, words, and tools, which shape children's activities. Each activity's components are organized into systems, forming a learning model that includes the subject, object, goal, tools, actions, functions affecting outcomes, rules, community, and division of labor. The reciprocal relationship between the learner and digital structures is known as “instrumental genesis,” a goal-oriented action

mediated by artifacts. Instrumental genesis progresses in two directions: (a) the artifact gradually gains capabilities and transforms into a tool for a specific purpose (instrumentalization or instrumental genesis) and (b) the student develops or internalizes cognitive schemes for instrumental action, gradually forming techniques (tool creation or instrumentation).

The **third unit** examines the design of computational learning environments rich in opportunities for meaning-making and dynamic representations. These environments act as "knowledge incubators" where students can transfer investigative habits from personal experiences to the formal language of scientific constructs. They are digital worlds where individuals can explore and learn through feedback provided by the environment in response to their exploration.

The **fourth unit** focuses on the reasoning forms used by novice and experienced designers of digital layouts and the techniques and methods for creating effective primary or secondary programming structures. The educational interest lies mainly in the problem analysis or situation assessment that precedes program writing, which serves as a basis for teaching logical thinking and algorithmic problem-solving in familiar contexts.