TEACHING IN THE DISCIPLINES & KEY ASPECTS OF LEARNING AND TEACHING IN SCIENCES (MATHEMATICS, CHEMISTRY, BIOLOGY, COMPUTING)

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PERSONAL APPLICATION TASK: DESIGNING AN INQUIRY-BASED CHEMISTRY LESSON

- **Task:**
  Imagine you are designing a chemistry lesson on acids and bases. Reflect on how you would structure the lesson to incorporate inquiry-based learning, drawing from your own experiences as a student.
- **Objective:** Apply inquiry-based learning to the teaching of chemistry and reflect on its impact.
- **Activity:**
  - Create a brief outline for a lesson plan on acids and bases, integrating an inquiry-based approach. Consider the following steps:
    - **Introduction:** How would you engage students' curiosity? (e.g., a real-world problem or an interesting question like "How does the acidity of soil affect plant growth?")
    - **Exploration:** How would students explore the concept on their own or in groups? (e.g., conducting experiments to test pH levels of various substances)
    - **Discussion and Reflection:** How would you guide students to make sense of their observations? (e.g., group discussions, guiding questions)
  - Reflect on how your own learning experiences influenced the way you would design this lesson.
- **Reflection Questions:**
  - How did your personal learning experiences shape the way you approach teaching chemistry?
  - What do you think are the main benefits of inquiry-based learning in a chemistry class?

A MODEL OF DISCIPLINE-SPECIFIC PEDAGOGICAL KNOWLEDGE

- In educational research, the notion of a model of discipline-specific pedagogical knowledge (DPK) has traditionally been examined within one of two distinct lines of research: **research on the knowledge base for teaching** or **research on disciplinary specificity in university teaching**.
- Within research on the knowledge base for teaching, **three components** have been found to play a particularly crucial role in guiding an academic's thinking about teaching:
- these components include the teacher's knowledge about teaching (the body of dynamic, relatively consensual, cognitive understandings that inform skillful teaching),
- his or her beliefs relating to teaching (personal and most often untested assumptions, premises or suppositions about instruction that guide one's teaching actions),
- and his or her goals relating to teaching (what a teacher is trying to accomplish, his or her expectations and intentions about instruction, be they short- or long-term).

TWO TYPES OF CHARACTERISTICS

- Within research on disciplinary specificity, **two types** of characteristics have been found to affect what one can do when teaching a given discipline:
- These include the socio-cultural characteristics of the discipline (characteristics that are socially constructed through the establishment of norms, practices or rules within a group of individuals)
- and the epistemological structure of the discipline (characteristics that directly depend upon how the field is structured).

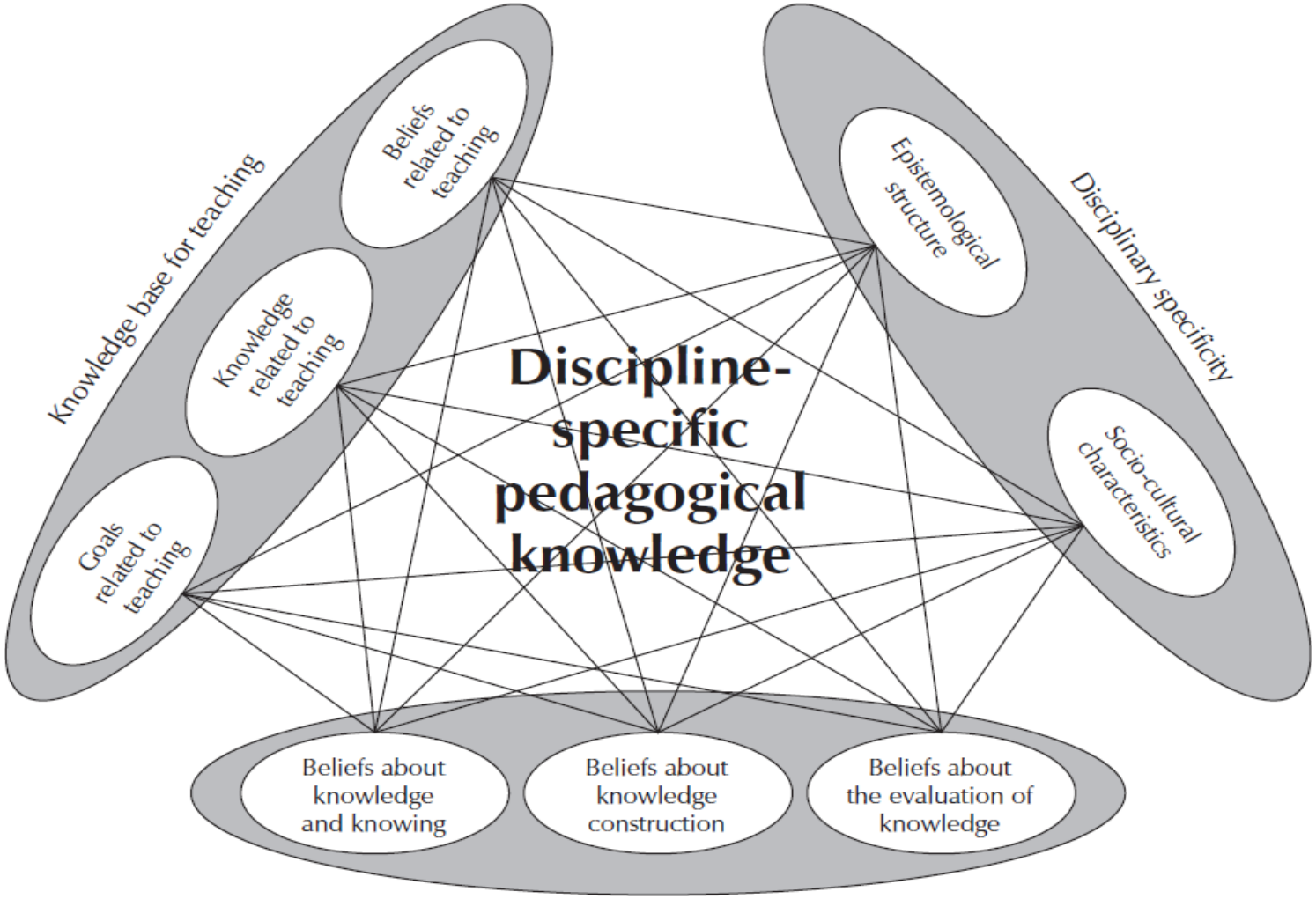
THREE ASPECTS

- Within research on personal **epistemology** (*Эпистемоло́гия — философско-методологическая дисциплина, исследующая знание как таковое, его строение, структуру, функционирование и развитие*), **three aspects** have been found to play a particularly important role:
- namely an individual's beliefs about knowledge and knowing (how one views what constitutes knowledge and the various actions associated with being able to know),
- his or her beliefs about knowledge construction (how one views the development or accumulation of knowledge),
- and his or her beliefs about the evaluation of knowledge (how one attributes more value to certain forms of knowledge than others).

JOHN DEWEY'S 4 PRINCIPLES OF EDUCATION

There are only a few ideas that had as much of an impact on education as those of **John Dewey**. The American philosopher, psychologist and educator believed children to be active contributors and agents of their learning, and not just passive recipients of knowledge of previous generations. He believed that for knowledge to be acquired successfully, learning should be an experience. His Experiential Learning approach was based on four core principles. To find out what these are and how it works in real life, watch our video.

MODEL OF DISCIPLINE-SPECIfiC PEDAGOGICAL KNOWLEDGE (DPK) FOR UNIVERSITY TEACHING



Which relationships seem to be most important for you when thinking and/or making decisions about your teaching?
Why are these relationships so important?

EXPERIENTIAL LEARNING THEORY WAS PROPOSED BY **DAVID KOLB**

- According to him, this type of learning can be defined as "the process whereby knowledge is created through the transformation of experience. So, if we evaluate our experiences, we can determine what to do next time and we will be able to change it in a good way. With that, we really learned from our experiences.
- There are the six propositions shared by foundational scholars:
- (1) Learning outcome is not the endpoint but simply a resting point of a learning process.
- (2) As we learn new ideas, we also modify and dispose of the old ones.
- (3) Effective learners are capable of balancing the opposing modes in the learning cycle.
- (4) Learning never ends.
- (5) When the learners and environment interact both are changed.
- (6) Every field requires unique skills and a special learning process.

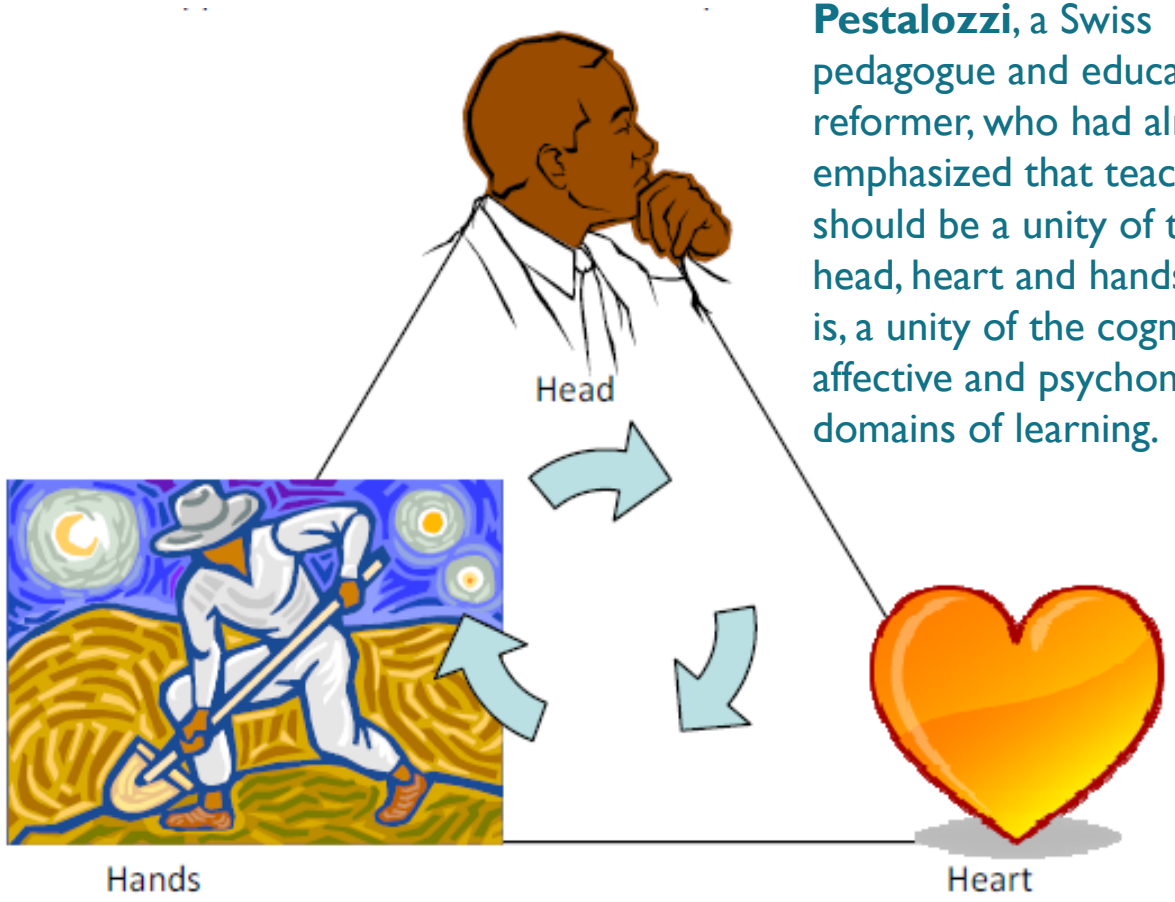
KEY ASPECTS OF LEARNING AND TEACHING IN EXPERIMENTAL SCIENCES

According to **Kolb**, this type of learning can be defined as "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combinations of grasping and transforming the experience." The experiential theory that proposed by Kolb takes a more holistic approach and emphasizes how experiences, including cognition, environmental factors, and emotions, influence the learning process.

PERSONAL APPLICATION TASK: APPLYING CONCEPT MAPPING IN BIOLOGY

- **Task:**
  Consider a biological topic that you found particularly challenging (e.g., cellular respiration, the process of photosynthesis). How would you use concept mapping to help students understand this topic?
- **Objective:** Use concept mapping as a tool for teaching and reflect on its effectiveness.
- **Activity:**
  - Create a concept map for a biological concept of your choice (e.g., the human circulatory system, plant structure and function, ecological relationships).
  - After creating the map, reflect on how it could help students organize their thoughts and see connections between different biological ideas.
  - Consider how you can use this strategy in a classroom setting and how it might improve students' understanding of complex biological processes.
- **Reflection Questions:**
  - How does creating a concept map help you understand the relationships between different biological concepts?
  - How can concept mapping be used in your future classroom to enhance students' learning in biology?

WHY THEY GO TOGETHER



It **was Johann Heinrich Pestalozzi**, a Swiss pedagogue and education reformer, who had already emphasized that teaching should be a unity of the head, heart and hands, that is, a unity of the cognitive, affective and psychomotor domains of learning.

Head: cognitive understanding, critical thinking; learning through readings, lecture, discussion, etc.
Hand: psychomotor, practice, learning by doing, getting a feel for how things actually work
Heart: affective/emotive, caring about the results, valuing the outcome, feeling that the process and goals are important, experiencing a personal connection
Why they go together: effective teaching through engaging students' heads will produce knowledge, but unless students put their learning into practice, they won't fully understand what they have learned, and won't know how to apply it. They will only make the effort to fully understand and put into practice what they learned if they feel that it is truly important to them and something that they care about.

10 TIPS FOR TEACHING ETHICS

- Make room for ethics
- Focus on relevant situations
- Focus on real-life experiences
- Highlight reasons and impacts
- Practice, practice, practice
- Challenge your student by adding complexity
- Give students the courage to ask the right questions
- Expose students to a variety of experiences
- Ethics Can't Just Come up in an Ethics Class
- Ethics isn't just about the student

PERSONAL APPLICATION TASK: INTEGRATING REAL-WORLD APPLICATIONS IN SCIENCE TEACHING

- **Task:**
  Think about a science topic you have learned (e.g., Newton's Laws of Motion, the process of photosynthesis, data analysis in computing). How would you integrate real-world applications into your teaching to make the concept more relevant to students?
- **Objective:** Enhance teaching strategies by integrating real-world applications to increase student engagement.
- **Activity:**
  - Choose a scientific concept that you would like to teach and identify at least three real-world applications of that concept.
  - For example, if teaching Newton's Laws of Motion, discuss how they apply to real-world scenarios such as car accidents, sports, or space exploration.
  - Develop a brief lesson plan that includes a real-world application of the concept. Consider how to engage students and help them see the relevance of the topic to their daily lives.
- **Reflection Questions:**
  - How does connecting science topics to real-world applications improve student engagement and understanding?
  - What real-world scenarios could you use to help your students connect scientific concepts to the world around them?