(Activating) Teaching Methods

Inquiry-Based, Game Based, & Personalized-based Methods

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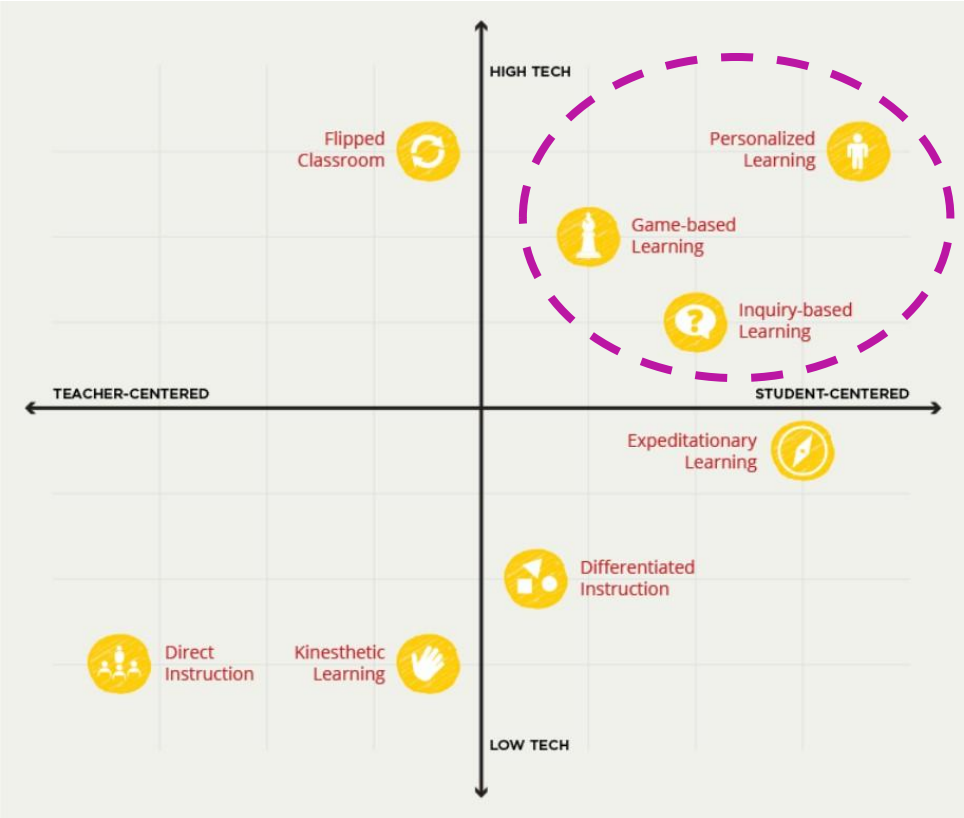
Teaching methods - Introduction

- It refers to the general principles, pedagogy and management strategies used for classroom instruction
- Depends on the course, class size, students background (educational, cultural), availability of resources and feasibility
- Teacher-centered and student-centered
- Low-tech and high-tech



References:https://teach.com/what/teachers-know/teaching-methods/

High-tech and Student-centered methods

- Student-centred/learning-based approach
- Facilitates deep learning
- Potential to invoke learning in highly demotivated/non-academic students as well
- Probability of creating students lot with independent and critical scientific thinking
- Requires considerable planning and efforts by teachers but with often desirable outcomes

References:https://teach.com/what/teachers-know/teaching-methods/

Defining inquiry-based learning

- *Roots in the discovery learning movement of the 1960s that critically responded to more traditional learning approaches highlighting e.g., memorization, direct instructions etc.*

- *Inquiry-based learning is an umbrella term encompassing a range of teaching methods in which:*
  - Learning is stimulated by a question or issue
  - Learning is based on constructing new knowledge and understanding following scientific methods and practices or similar
  - Teacher has the role of a facilitator
  - Self-directed learning and a learner's responsibility in discovering knowledge is encouraged
  - The learning process is often collaborative and supported by the use of advanced technology

References: Lee et al. 2004; de Jong & van Joolingen 1998; Keselman 2003; Pedaste & Sarapuu 2006; Bell et al. 2009; Spronken-Smith et al. 2011; Padaste et al. 2015

Inquiry cycle

- From a pedagogical perspective, inquiry-based learning can be approached as **an inquiry cycle with different phases** that engages students in an scientific discovery process
- Many versions of the cycle can be found in the literature
- An example of the phases forming the cycle by Padaste et al. (2015):

1. Orientation, 2. Conceptualization, 3. Investigation, 4. Conclusion, and 5. Discussion

Source: Pedaste, M., Mäeots, M., Siiman, L. A., De Jong, T., Van Riesen, S. A., Kamp, E. T., ... & Tsourlidaki, E. (2015). Phases of inquiry-based learning: Definitions and the inquiry cycle. *Educational research review*, *14*, 47-61.

Phases of inquiry cycle (1-2)

1. **Orientation:** about *stimulating curiosity* about the topic and a*ddressing a learning challenge* through a learning statement

2. **Conceptualization:** The phase in which *theory-based questions* or *hypotheses are formulated*

    ***2.1 Questioning*:** The process of generating research questions based on the stated problem

    2.2 Hypothesis generation:The process of generating hypothesis regarding the stated problem

Source: Pedaste, M., Mäeots, M., Siiman, L. A., De Jong, T., Van Riesen, S. A., Kamp, E. T., ... & Tsourlidaki, E. (2015). Phases of inquiry-based learning: Definitions and the inquiry cycle. *Educational research review*, *14*, 47-61.

Phases of inquiry cycle (3)

3. Investigation: The process of planning *exploration* or *experimentation*, *collecting and analyzing data based on experimental design or exploration*

1. ***Exploration***: The process of systematic data generation on the basis of research questions
2. ***Experimentation***: The process of designing and conducting an experiment in order to test a hypothesis
3. ***Data interpretation***: The process of making meaning out of collected data and synthesizing new knowledge

Source: Pedaste, M., Mäeots, M., Siiman, L. A., De Jong, T., Van Riesen, S. A., Kamp, E. T., ... & Tsourlidaki, E. (2015). Phases of inquiry-based learning: Definitions and the inquiry cycle. *Educational research review*, *14*, 47-61.

Phases of inquiry cycle (4-5)

4. Conclusion: The process of *drawing conclusions from the data. Comparing inferences based on data with hypothesis or research question*

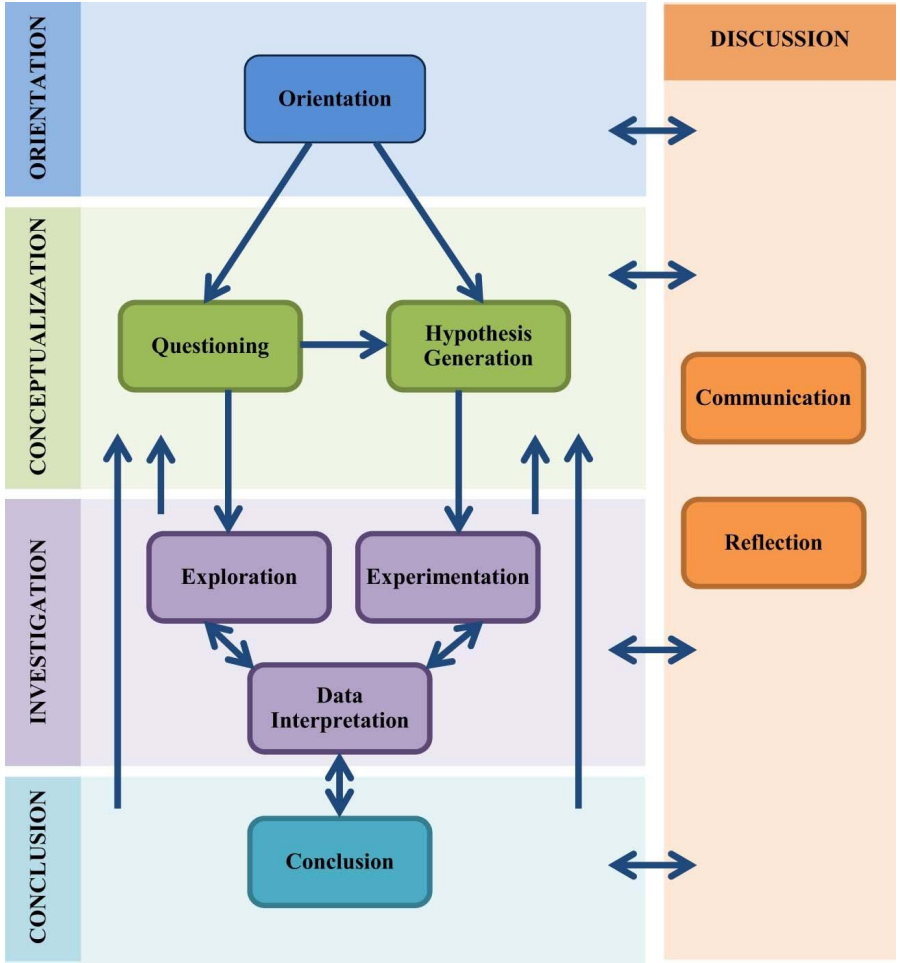
5. Discussion: About *presenting findings* on particular phases or the whole inquiry cycle by *communicating with others and/or controlling the whole learning process or its phases by engaging in reflective activities*

1. ***Communication***: The process of presenting the outcomes to others and collecting feedback. Discussing with others.
2. ***Reflection***: The process of describing, critiquing, evaluating and discussing the whole inquiry cycle or a specific phase. Inner discussion.

Source: Pedaste, M., Mäeots, M., Siiman, L. A., De Jong, T., Van Riesen, S. A., Kamp, E. T., ... & Tsourlidaki, E. (2015). Phases of inquiry-based learning: Definitions and the inquiry cycle. *Educational research review*, *14*, 47-61.

Inquiry-based learning framework

- Can be utilized in designing effective inquiry-based learning strategies in education



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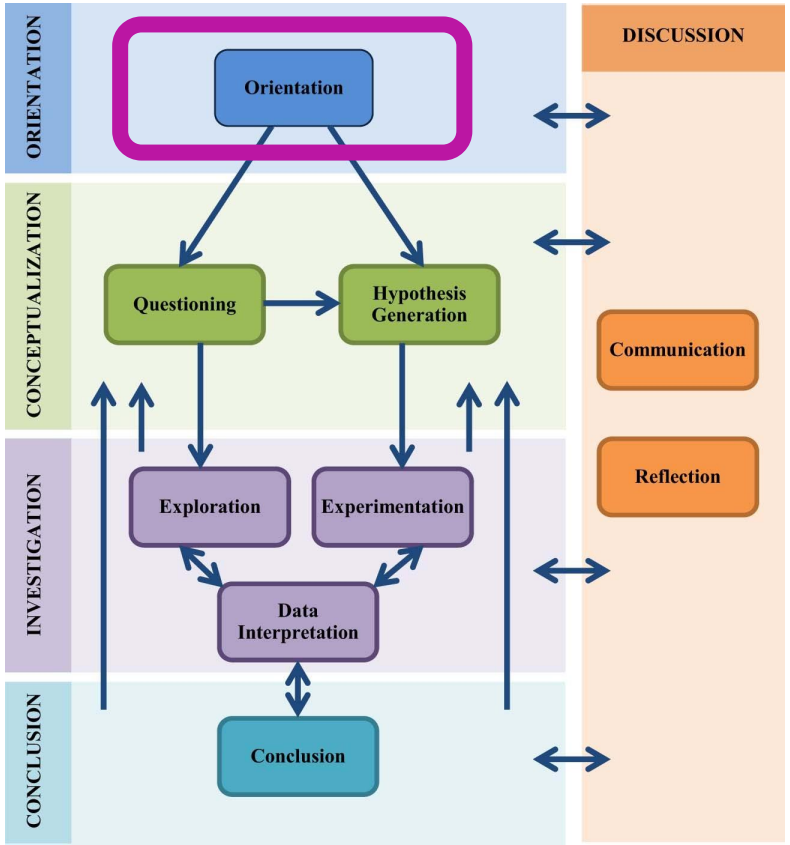
Implementation Example

Ask students,

"What is mass?"

Then hold up a piece of bubble gum and ask the students,

"What will happen to the mass (weight) of this piece of bubble gum when I chew it?"



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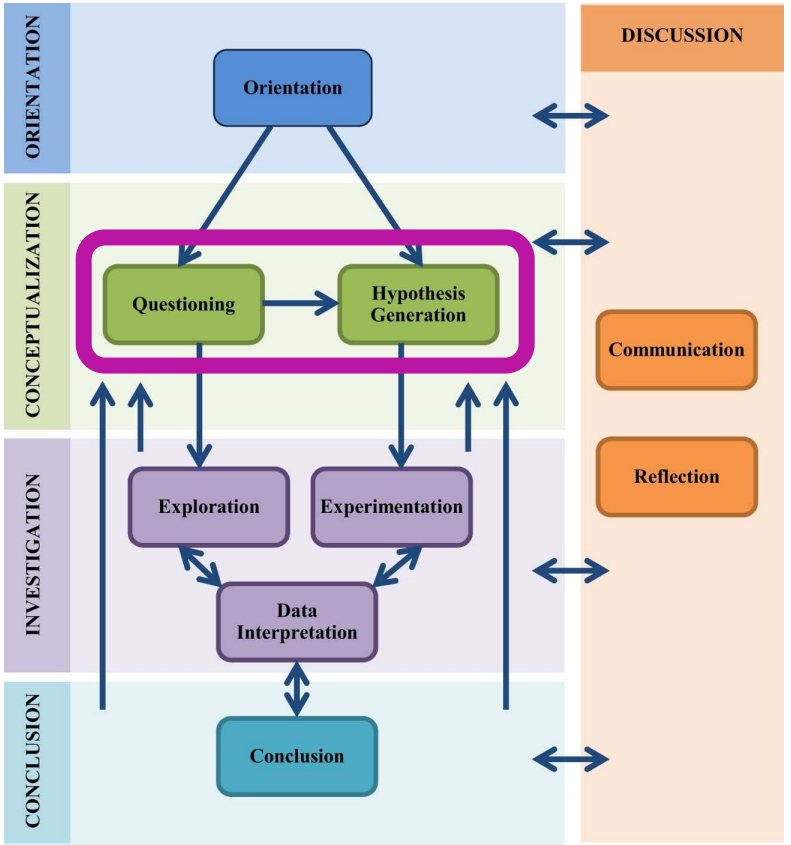
Implementation Example

Select a few students to offer their definition.

Your hypothesis is:



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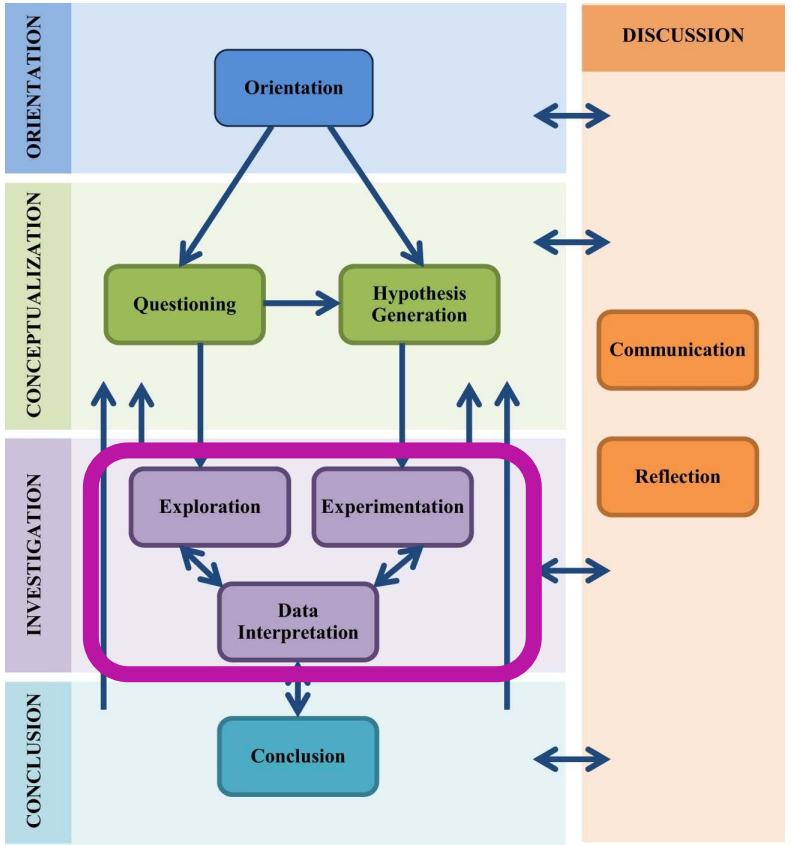
Implementation Example

Materials needed:
- weighing device
- bubble gum

Procedure:
- Weigh one piece of bubble gum. Record the mass.
- develop a hypothesis on the effect chewing will have on the mass of the bubble gum. Record the hypothesis.
- Chew the bubble gum for 30 sec. Determine the mass of the bubble gum. Record the mass.
- Repeat recording for 5 min.
- Graph the results of your findings.
- Evaluate your hypothesis.

Time	00:00	00:30	01:00	01:30	02:00	02:30	03:00	03:30	04:00	04:30	05:00
Mass											



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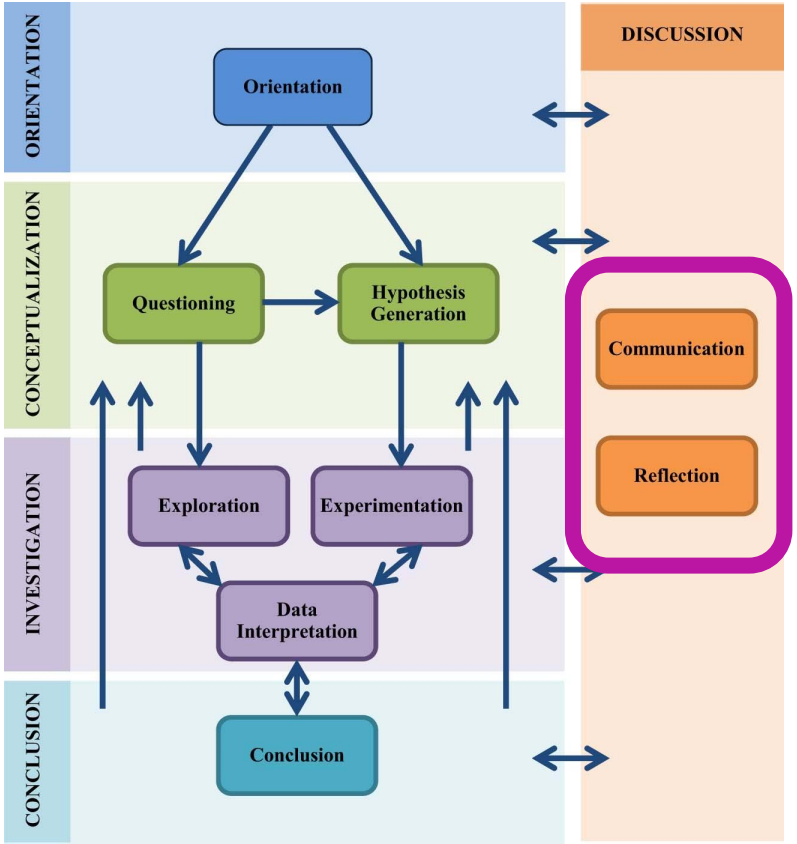
Implementation Example

Discussion Guiding Questions:

- What were the most difficult aspects of conducting this experiment?
- Did the experimental procedures produce the desired results?
  - Were you able to answer the research question?
- What would you do differently in conducting this experiment a second time?
- Why did the rate at which the mass changed slow down?



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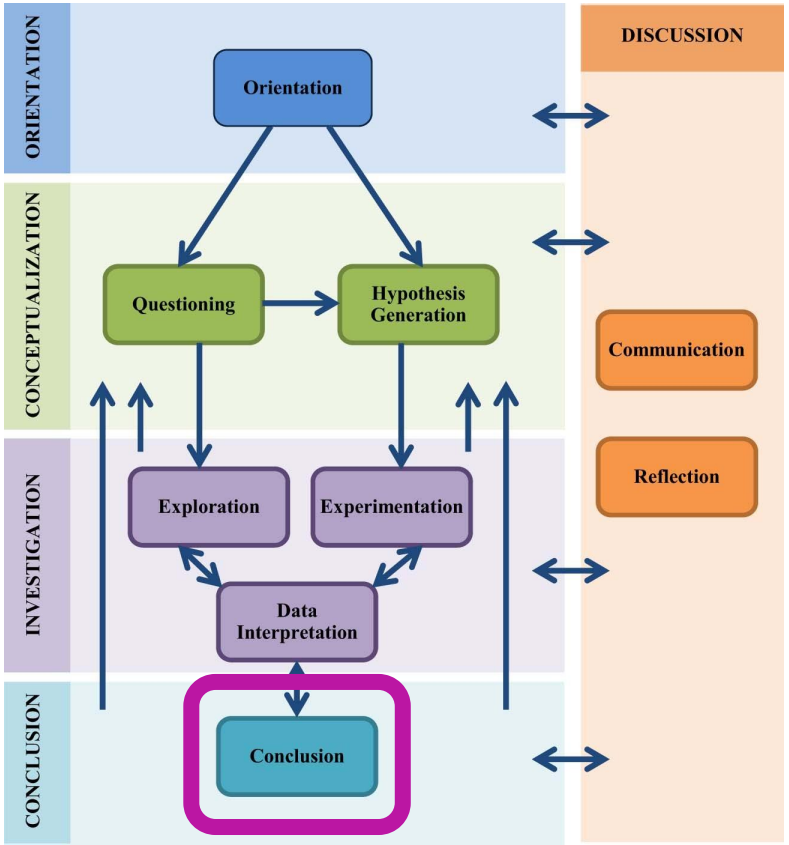
Implementation Example

- What was your hypothesis?
  - Was it "***correct*** "?
- What is the ***dependent variable*** in this experiment?
- What is the ***independent variable*** in this experiment?



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Game-based Learning model

- “using games in educational contexts to reach educational objectives” [1].

- GBL makes learning and instruction fun and immersive. Games give experiences meaning, they provide a set of boundaries within a safe environment, to explore, think, and try things out. They provide the motivation to succeed and reduce the sting of failure.

- Games are an ideal learning environment, with their built-in permission to fail, encouragement of out-of-box thinking, and sense of control.

[1] Connolly, T. M., Boyle, E. A., MacArthur, E., Hainey, T., and Boyle, J. M. (2012). A systematic literature review of empirical evidence on computer games and serious games. *Comput. Educ.* 59, 661–686. doi: 10.1016/j.compedu.2012.03.004

Game-based Learning model

- The basic structure of GBL consists of three key elements: a challenge, a response, and feedback
  - A loop is generated when the feedback constitutes a new challenge or prompts the player to provide a different response to the original challenge.

[1] Vocaturo E, Zumpano E, Caroprese L, Pagliuso SM, Lappano D. Educational Games for Cultural Heritage. InVIPERC@ IRCDL 2019 Jan 30 (pp. 95-106).

Game-based Learning Example

https://www.youtube.com/watch?v=d_1NU8Lm_bg

Personalized Learning

- Adaptation of teaching experience to a student's unique combination of
  - goals
  - interests
  - competences
- Continuous shifting of instructions as these change

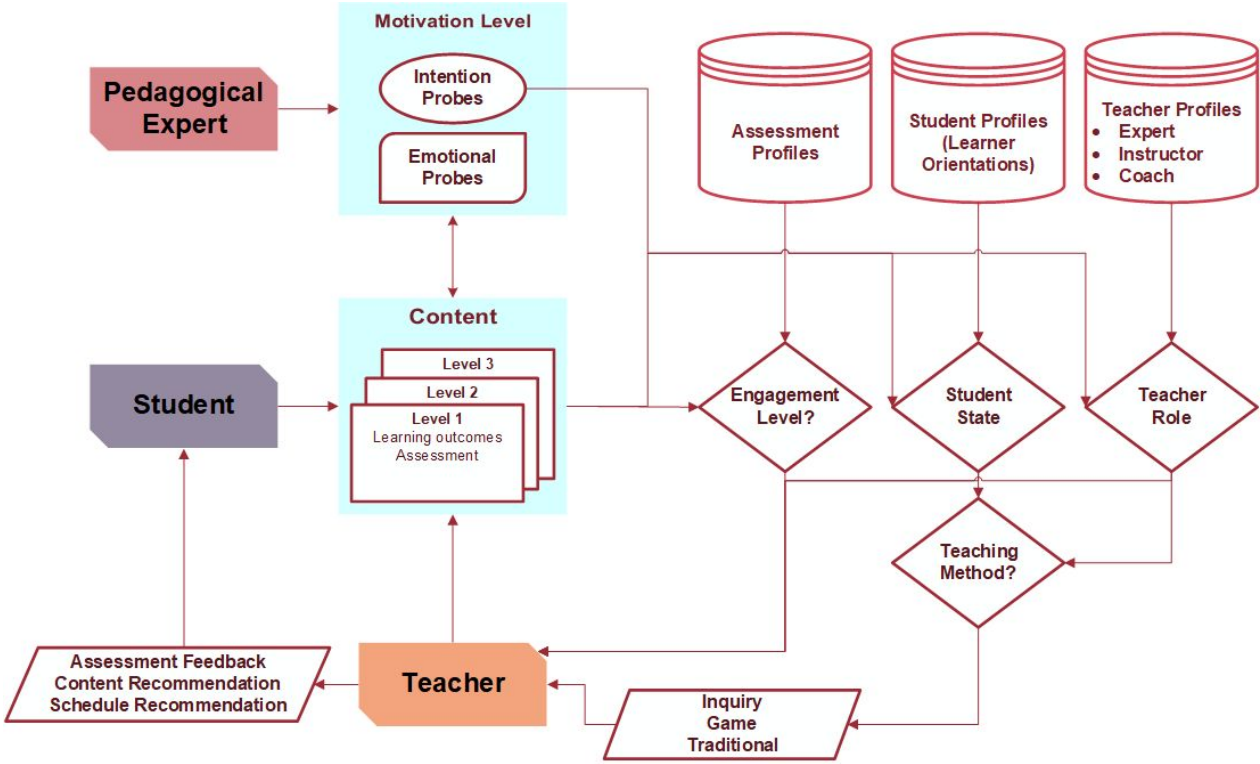
- **Augment teachers with technology to facilitate individual learning experience**
  - One teacher - one student
    (for rich people)

References:

- *Bulger, Monica. "Personalized learning: The conversations we're not having." Data and Society 22.1 (2016): 1-29.*
- *Martinez, Margaret. "Key design considerations for personalized learning on the web." Journal of Educational Technology & Society 4.1 (2001): 26-40.*

Tech-augmented learning

- **A simplified adaptive personalized learning system**
  - Motivation level of the student is the key factor
  - Teacher's role changes as the student's state changes
  - Teaching method might also be modified
  - Content and assessment methods must be adaptive



System components

- **Teaching technologies**
  - Often take into account cognitive factors that affect how knowledge is
    - built
    - processed
    - stored

    that are affected by learners' ability
    - attention
    - memory
    - reasoning
  - **however, personal differences arise due to**
    - **emotions**
    - **intentions**
    - **social impacts**
- **Pedagogical Experts/Psychologists can help in embedding probes in the content/exercises for estimating**
  - intentions
  - emotions
- **Content must have different levels of details to achieve the same learning outcome**
  - for each level the assessment must be different
  - schedule should be modified
- **Teacher is responsible for**
  - Creating different contents
  - Group/game assignments
  - Coordinate with the student

Student and teachers

Learning orientations

- **Transforming learner**
  - Intrinsic motivated
- **Performing Learner**
  - Achievement and socially motivated
  - Intents to learn selectively
  - Prefers instructor or coach
- **Conforming Learner**
  - Extrinsically motivated
  - Emotionally fragile but maximizes effort in supportive environments
  - Requires instructor or coach
- **Resistant learner**
  - Focuses on not cooperating
  - Resists to achieve goals assigned by others

Teacher roles

- Expert
  - knowledgeable person
  - passionate about the topic
- Instructor
  - clear understanding of the objectives and required steps
- Coach
  - experience in creating/finding different exercises based on different teaching methods
  - Supportive person for
    - supervision (emotionally, intent-wise and socially)
    - facilitating students

Role of the system

System performs several classification tasks <u>to direct the student toward transforming learner</u>

- **Engagement level**
  - estimates the difficulty level the student can effectively handle using
    - template profiles
    - historical and module-wise student performance metrics
    - current intent and emotional state of the student

- **Student State**
  - estimates student orientation at a given time
  - student progress measures trigger engagement level adjustment
  - student intent and emotional state trigger modifications in schedule
- **Teacher's role**
  - Select the best role for the teacher depending on the student's state

Conclusion: pros and cons

Pros;

- ➔ Technology might level the unequal distribution of learning opportunities (among the nations)
- ➔ Student-centered methods drive average student orientation toward ***performing learners*** if not ***transforming learners***
  - ◆ **Motivation** is gradually shifted from extrinsic to intrinsic motivation by continuously challenging the current comfort-zone in appropriate level
  - ◆ **Deep learning** is achieved by
    - Applying the new knowledge for a purpose
    - Explaining/teaching to the peers

Limitations; possible problems;

- ➔ Availability, penetration and acceptance of the ICT technologies are highly unequal round the world
- ➔ Students' and teachers' readiness to effectively use the technology requires a shift in the education ecosystem
  - ◆ Statistically no impact, if teachers' are not able to use the personalized learning technology effectively
  - ◆ Relatively lower technology methods are more successful, e.g. inquiry-based learning
- ➔ Teachers must be able to act as tech staff and educators simultaneously
- ➔ Teachers must be able to switch roles for each student