Attentive Teaching as a means for individual conceptual changes in physics studies

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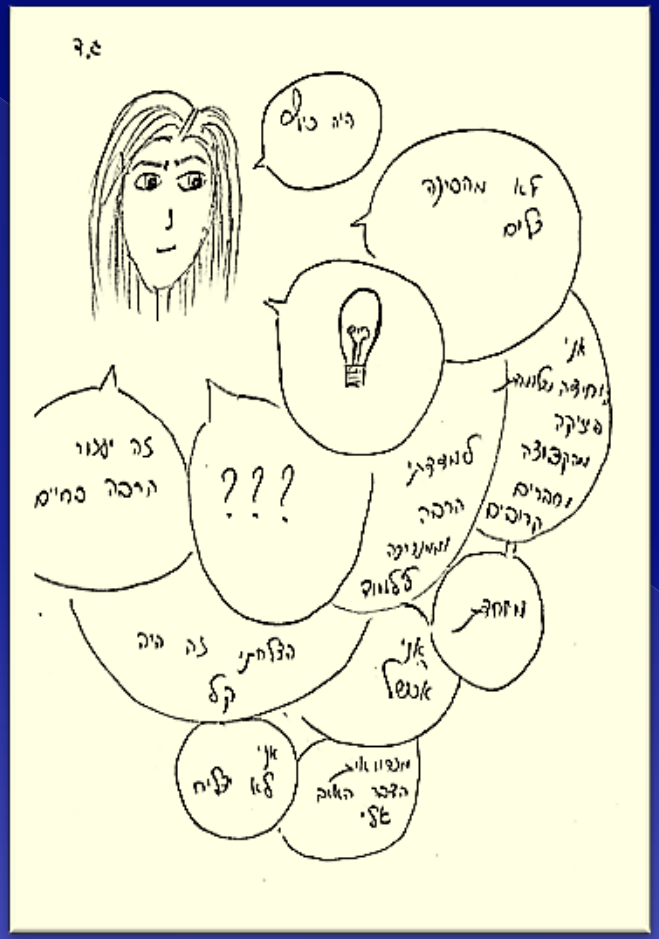
Involving the students in refraction learning



Attentive Teaching

Listening to the real place of the learners in the process of understanding

- Attentive Teaching relates to the conceptual change process in real time in classroom teaching . The change of concepts of each student is unique and can be seen. In this study we will show that the use of Thinking Journey instruction in the classroom enables students to change their conceptual understanding. Each student experiences a different learning path towards her unique way of understanding.

Conceptual Change Process

- The Constructivist Approach: Relating to defined notions of students in the process of scientific understanding. The passage between different notions is ideally portrayed. All the students are expected to go through the same conceptual itinerary. Even students from different cultures are expected to have similar notions of the concepts and order towards the scientific notion.
- We would like to show the individual nature of the conceptual change process that students experienced in the classroom using Attentive Teaching pedagogy allowing the students to connect their knowledge with observations of environments created in the students' minds.

Initial Assignment

Imagine that suddenly you became very small, even smaller than a dot on a piece of paper. You are situated inside a drop of water. How does the world around you is seen to you, now?

Draw it and explain your answer in details.

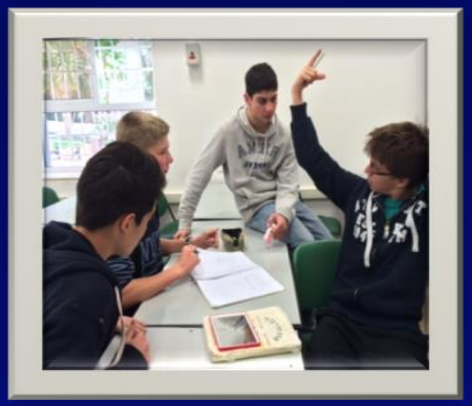
The goals of TJ

- Enabling students change their conceptual understanding
- Connecting between conceptual understanding and observations of relevant environments
- Overcoming egocentric understanding of students

Ingredients of TJ

- Creating mediated dialogues in the classroom, enabling the students present their understanding
- Designing the perspectives, environments and contexts needed for constructing the learnt concept
- The use of a variety of teaching languages, emphasizing visual representations
- Active participation of both: teacher and students
- Empowering the students

Methodology



- The qualitative study examined the conceptual understanding process of 5 students who learnt in a class of 14 students in 10th grade who studied the topic of refraction. The students experienced four creative mediated interactions in the classroom that created Thinking Journey and were interviewed in the process of their learning.

Findings

Students' drawings: Big and distorted environments

AVITAL

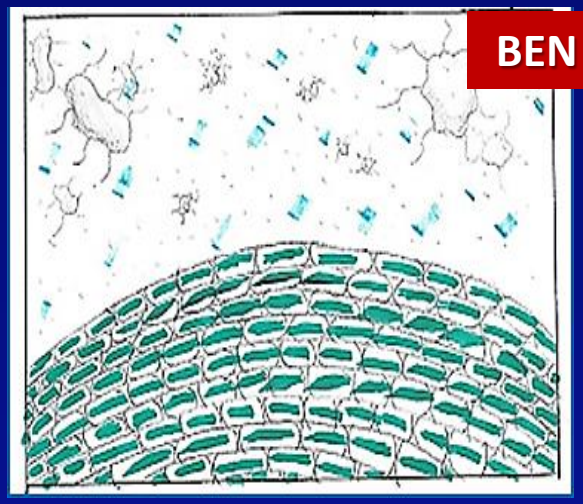
GALI

Students' drawings: Nearest Objects

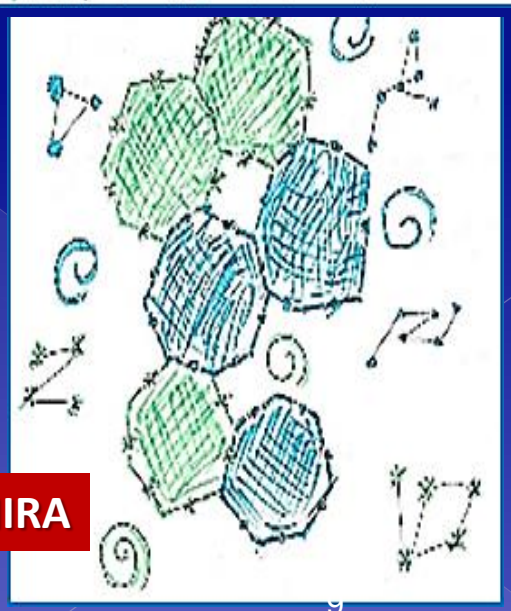
CHEN

Students' drawings: very small objects

BEN



SHIRA



Uncertainty processes of students

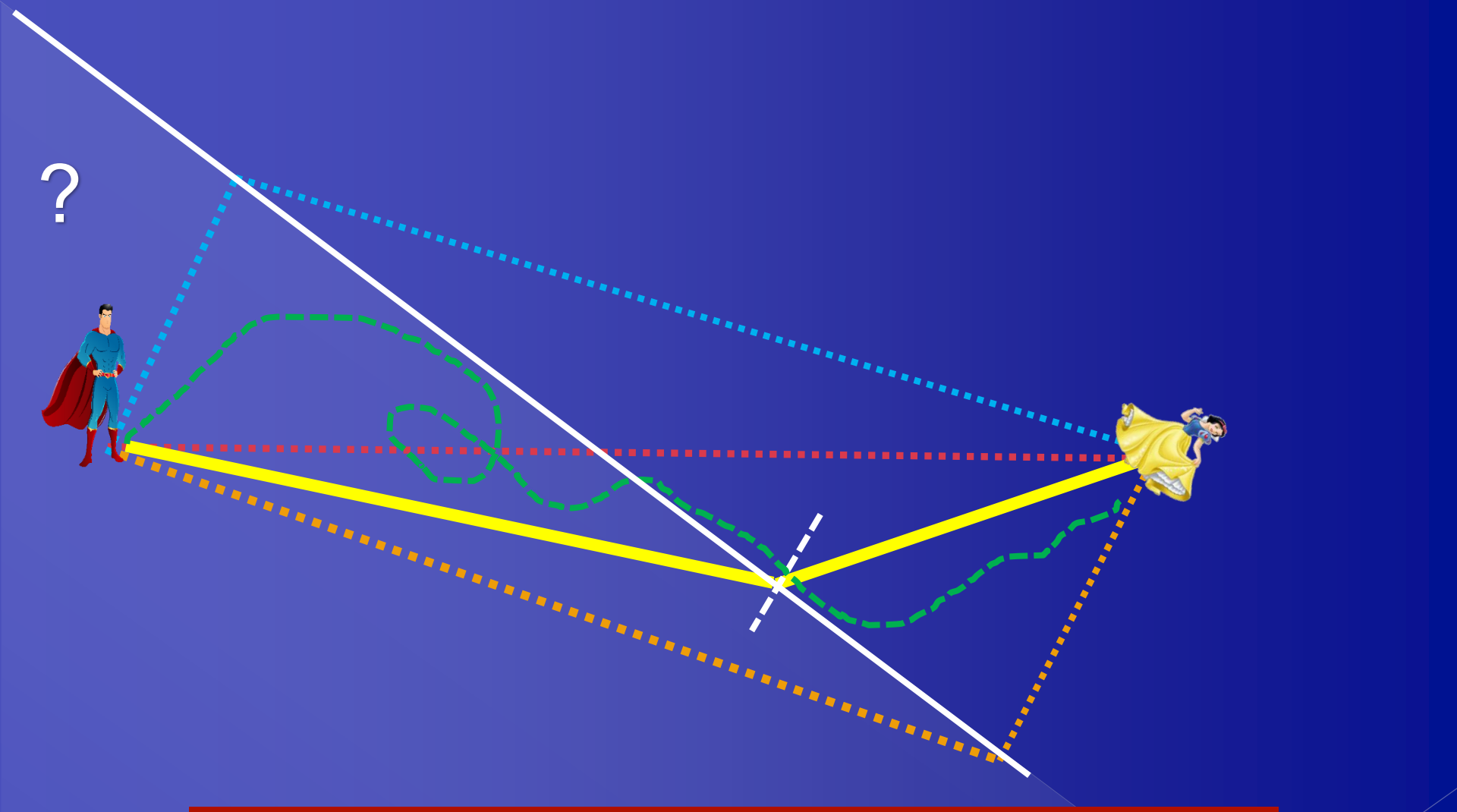
The process of tackling a challenging problem

- **AVITAL** — The assignment was difficult. I don't remember learning about it
- **GALI** — Trying to think as a "scientist" and a regular human being at the same time
- **SHIRA** — Like to imagine
- **CHEN** — It is quite strange to imagine in a lesson. In a lesson one should learn
- **BEN** — There is no false answer

2nd mediated interaction

?

Imagine you are the light. You can move really fast. But you can think even faster. In this respect you are better than Superman. You know that your velocity in the water is slower than on the beach. Draw the itinerary, that will enable you save the drowning beauty



Different solutions of students:
What is the best itinerary for the best integration of the velocities on the beach and water?
The line should be broken!!!

Third mediated interaction:
A man in the water – False picture

Which picture is false?
What is wrong in it?
Draw your cognitive process

All the students gave the right answer.
Shira and Avital: Comparing to imaginary depth. A man in the water should look different than without water, like the coin in the jar.
Gali, Ben and Chen: A stick in the water looks broken because of refraction (Snell's law). Therefore a man should also seem broken.

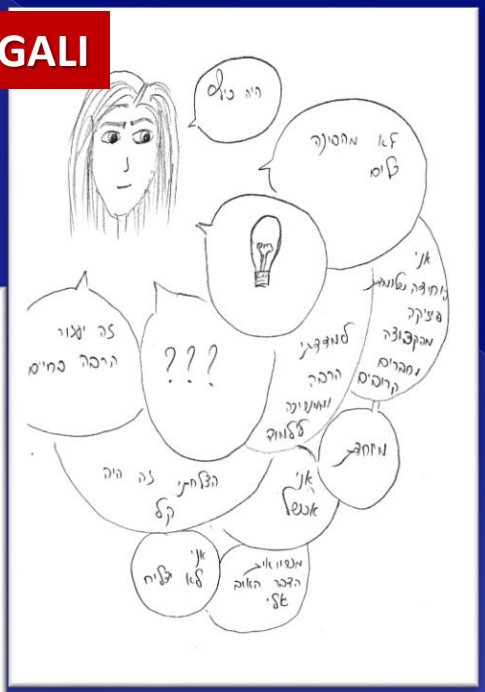
SHIRA , AVITAL

GALI , BEN ,CHEN

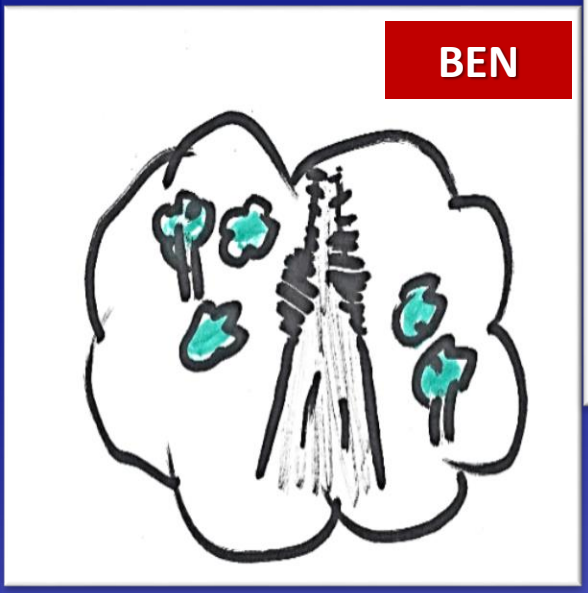
Uncertainty processes in learning

AVITAL

GALI

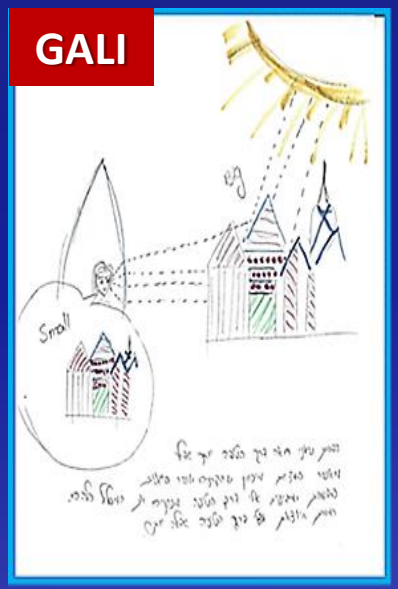


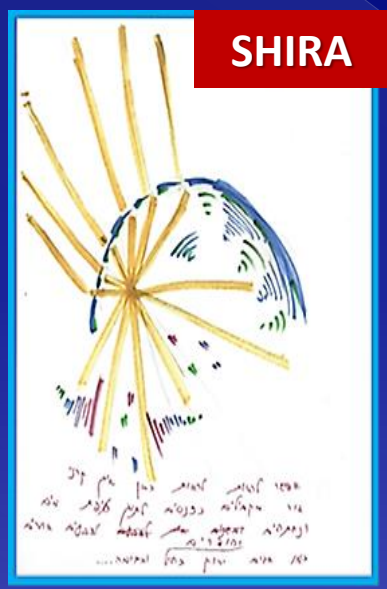
BEN

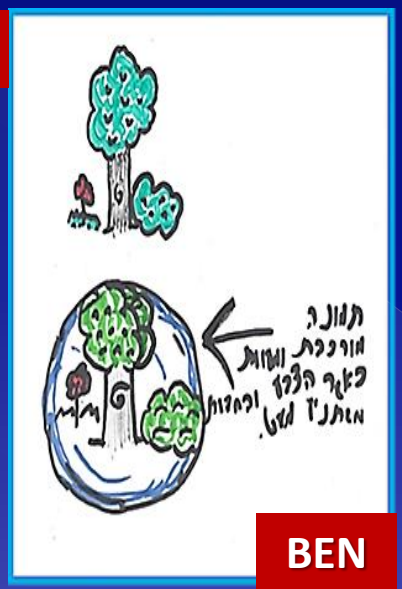


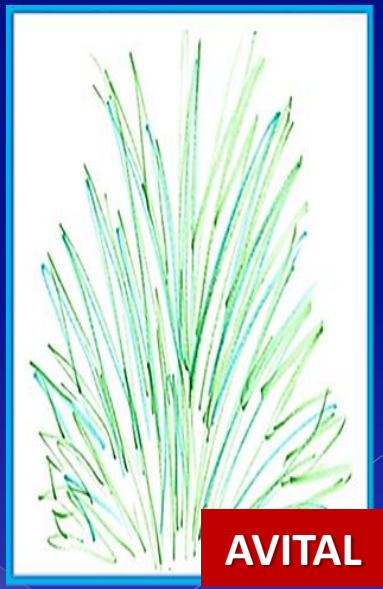
CHEN

4th mediated interaction.
View from a drop of water – after learning

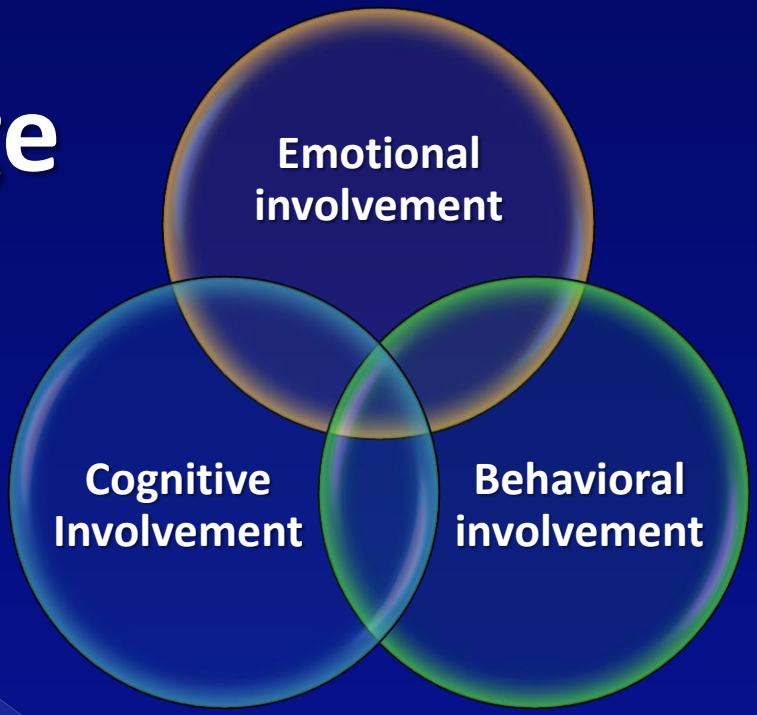








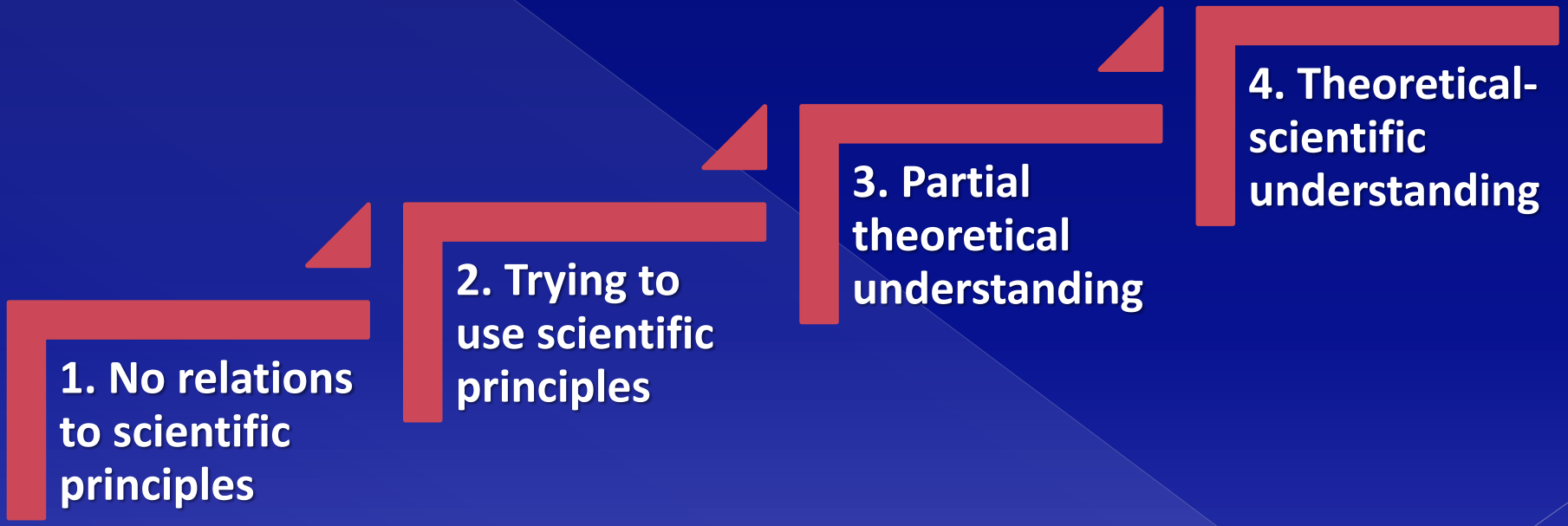
Conceptual Change Process in TJ



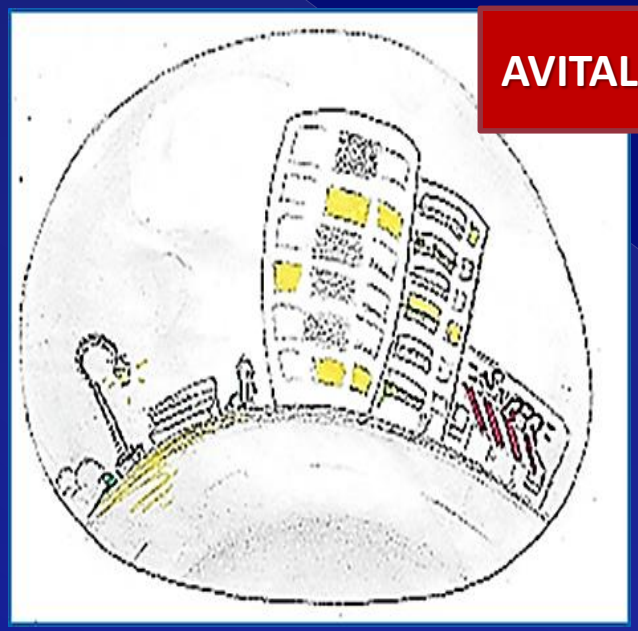
Using imagination, learning in contexts, using visual tools

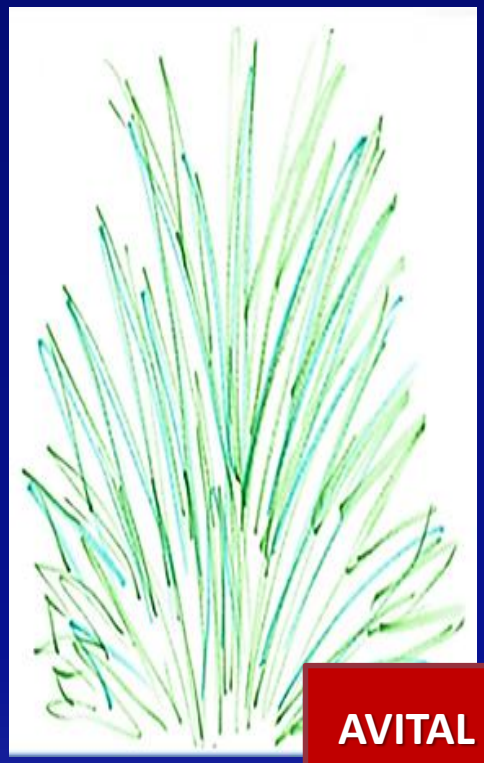
Enabling students to understand

Analysis of levels of understanding



1. No relation to scientific principles



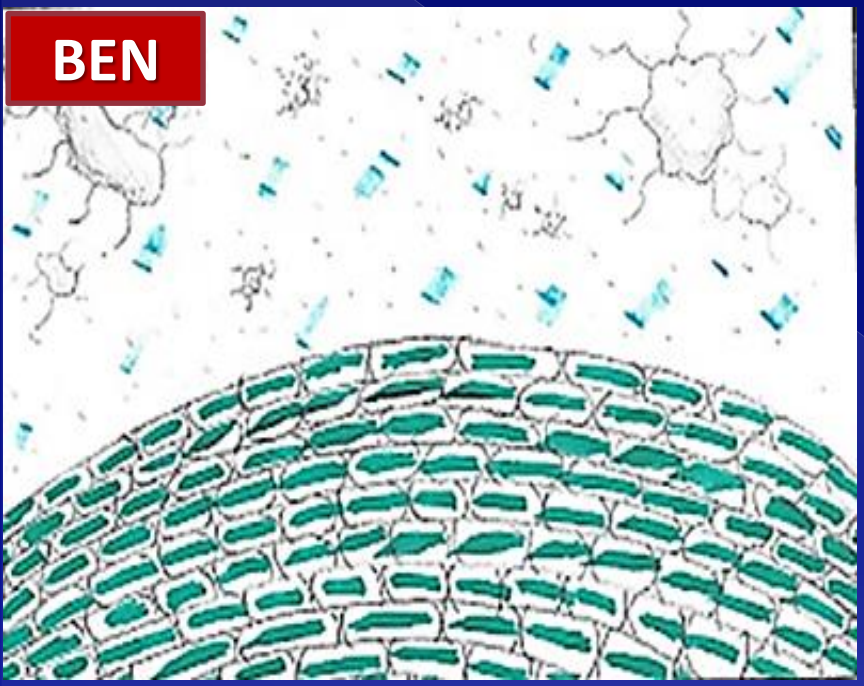


Not even initial trial to express the learnt knowledge. No connections between the drawings and scientific principles
Many emotions expressed. A lot of difficulties. Still optimistic in looking towards the future

2. Trying to use scientific principles

There are initial relations to scientific principles.
Only in the last minute she saw some light through the clouds

3. Partial theoretical understanding

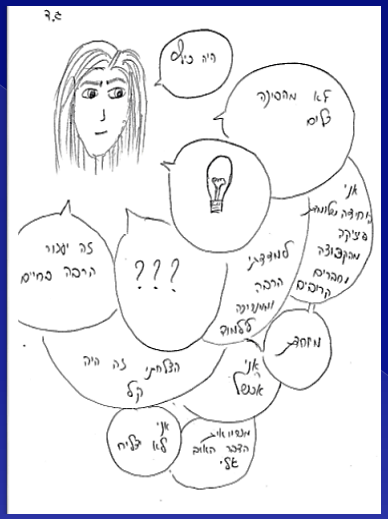


From the very small to relating to the changes between regular observation and the one through the water drop. The picture is distorted and the color changes

Going across the ditch – moving towards understanding

4. Theoretical-scientific understanding

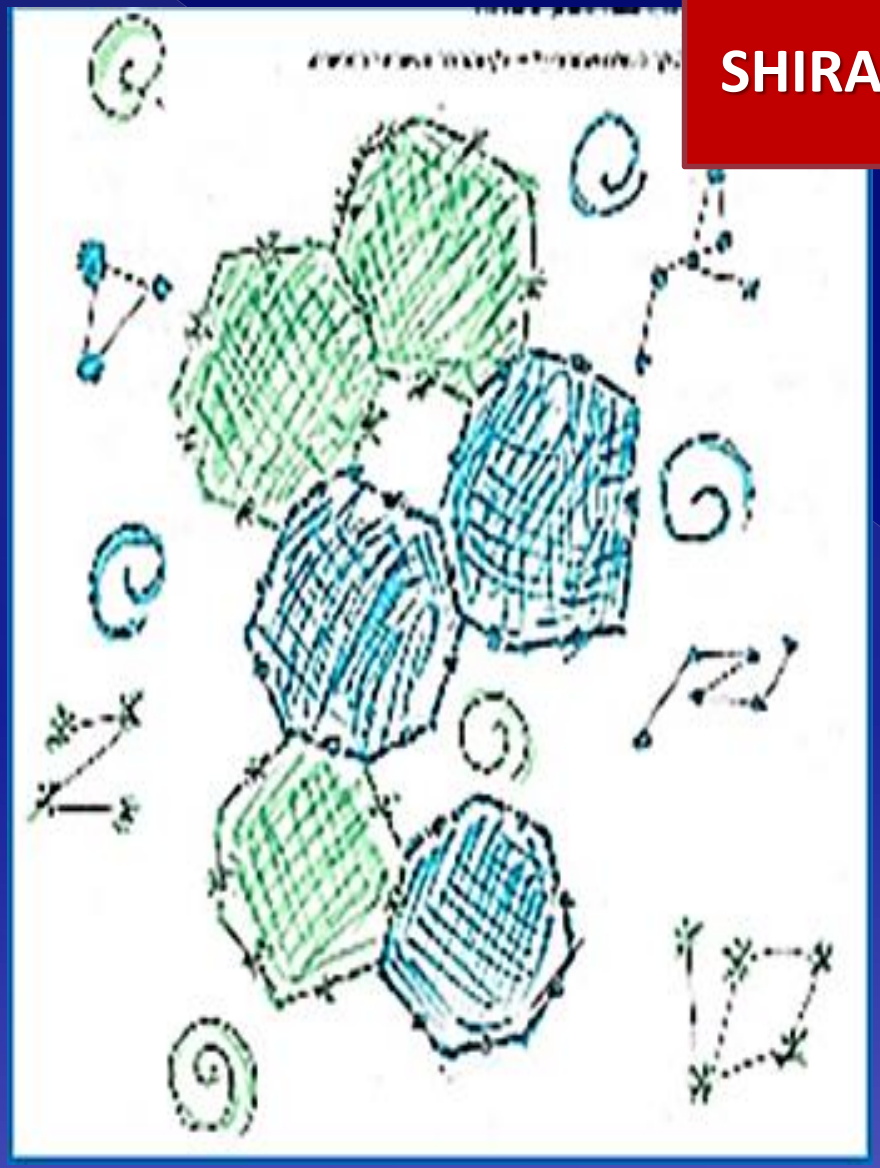
GALI



GALI

From general view to expressing the processes of being able to see an object through its lighting, reflection and refraction
Putting question marks, feelings of failures and uncertainty, and then a bulb symbolizes a clear view of the answer

4. Theoretical-scientific understanding



Summary

The teacher experiences the use of new teaching tools that enabled her to relate to the unexpected learning processes she encountered and to be attentive to the individual learning path of each student. The use of drawings enables seeing the real learning and conceptual change processes.

Mediated interactions

A variety of teaching languages,

An ongoing dialogue, Developing flexibility of the teaching and learning process. Mutual and active learning

Improvement of understanding processes

Relating to cognitive and emotional processes.

Developing reflective thinking of the students, conceptualization, interior motivation of the students

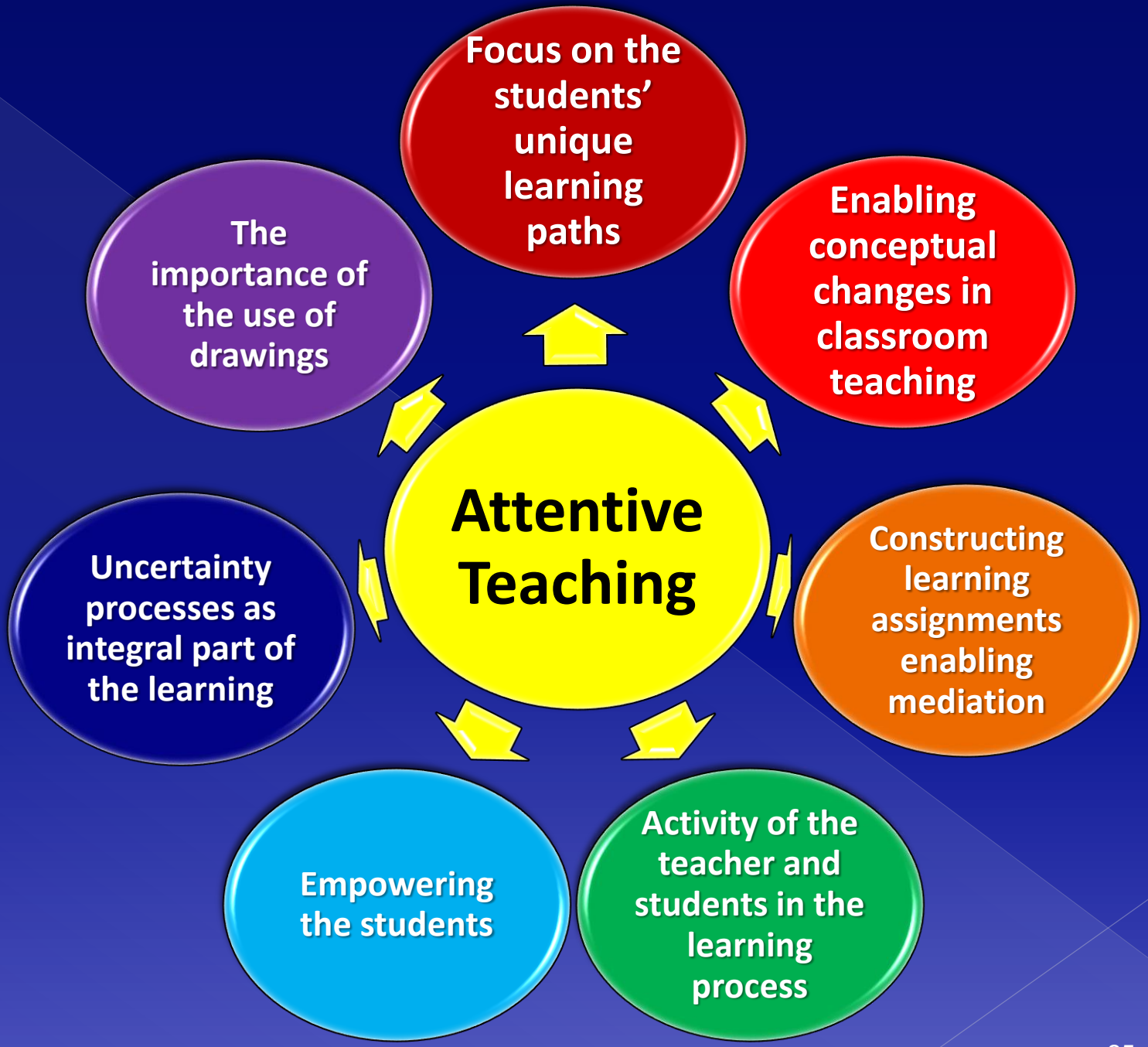
Dynamic Learning

Most of the students in the classroom experienced a shift from sensual representation of the environment to an understanding connected to the senses and even theoretical understanding.

Attentive teaching in the classroom

Improved communication between the teacher and the learners.

Developing new spaces of learning. Experiencing a meaningful teaching. Listening to the unique places of the learners in the process


Attentive Teaching
Focus on the students' unique learning paths
Enabling conceptual changes in classroom teaching
Constructing learning assignments enabling mediation
Activity of the teacher and students in the learning process
Empowering the students
Uncertainty processes as integral part of the learning
The importance of the use of drawings

Thank you!