Thinking Journeys in the Classroom – the Power of Uncertainty and Mediation

Yaron Schur examines the emotional processes at the heart of learning and explores how the Thinking Journey approach, based on Feuerstein's ideas, can make learning meaningful to children and help transform teaching.

An overview of the "journey"

In order to teach for understanding teachers have to be bold and attentive at the same time. Teaching for understanding requires that students change their initial understanding of concepts. Experiencing change processes is not easy for the students. It involves emotional confusion and sometimes resistance to the teaching offered. The emotional processes that involve curiosity and a willingness to learn new knowledge are called, 'uncertainty processes'. These require students to leave their comfort zone and experience meaningful learning, whilst going through these uncertainty processes. Therefore, it is important to mediate with a combination of empathy and assertiveness. Reuven Feuerstein's approach is concerned with cognitive change processes. His work provides multiple examples

of enabling children to go through meaningful change and how to construct teaching methods for meaningful understanding of subject matter.

The Thinking Journey (TJ) mode of instruction is based on mediated interactions in subject matter teaching. It was developed in a classroom of low functioning students who learnt astronomy. Conceptual change processes occurred through a journey in the mind of these students to unexpected environments that provided new perspectives of concepts. It was found that change processes only occur when the student is prepared to move beyond their egocentric perception of a concept, meet learnt concepts in unknown contexts, and experience using these concepts as a means to orient to new environments.

Believing in and challenging children

Reuven Feuerstein was a great believer in the ability of human beings to change their cognitive abilities. His belief was not only directed generally but always focused specifically on the child in front of him. His mediation, that is, the quality of his intervention, was always on two levels; first, related to finding ways to enable the child to experience meaningful cognitive change and enable the child to solve the given problem or task set before her; and secondly, to explain these cognitive changes to observing parents and teaching experts gathered in his room to watch him work with a child. In this manner, Feuerstein always considered the perspective of both the child and the mediator (the teacher or parent) during these short mediated interactions, always looking for the positive aspects of the functioning of the childFeuerstein's dialogue with children, which occurred at the beginning of treatment processes, seemed to me very similar to classroom teaching, even though it was done on an individual basis. Feuerstein usually worked with very low functioning children. He listened carefully to their cognitive difficulties, and enabled them to feel able to feel successful when they solved different problems.

Feuerstein's first assessment session with a child involved a mediated interaction that was the first step in treating a child, where cognitive change processes were constructed from a series of mediated interactions. Belief in the ability of the child to change was expressed through the fact that Feuerstein never tried to predict what the outcome of an encounter might be. Even children with severe problems were asked to participate in the learing process. The mediated interaction with the child allowed him to concentrate on the current situation, without yet determining long term goals. and it was these small changes that showed him how to proceed. In this manner, each change was a starting point for the next. Believing in the child meant challenging her. The processes observed in Feuerstein's room while working with low functioning students thus served as an example for classroom teaching of regular students that also tackle challenging learning assignments.

Lifelong learning and variety of voices

Feuerstein's Mediated Learning Experience (MLE) (Feuerstein et al., 2006) is relevant to two main challenges facing current classroom teaching. On the one hand, the changing era demands students to be able to cope with the constant changes of our age, meaning that they have to be able to continue learning throughout life. Experiencing meaningful changes, even small ones, enables children and adults at any age change their feeling of competence and know that they can improve their ability to learn. At the same time, classes nowadays are composed of students that come from a variety of backgrounds, and teachers need to be able to listen to the variety of voices of the class. MLE gives educators the tools to listen to the cognitive difficulties of students in the class and enable students to use strategies for tackling the different assignments that they have to face.

Feuerstein's focus on change processes made him concentrate on the cognitive processes of students. As he rightly emphasized that it would be much easier to enable mediatees to change, if mediation were to focus on the thinking processes. In order to enable students experience cognitive change he tried as much as possible to use tools that did not include the need for content knowledge. Feuerstein et al. (1991) claimed that content knowledge posed a much higher degree of difficulty of change in comparison to a content free context. The

Instrumental Enrichment program was constructed along this line of thought, with the goal of enabling students to experience cognitive changes that could be later bridged to tackle learning content knowledge.

Encountering Feuerstein's ideas

When I came to work at the Feuerstein Institute in Jerusalem in 1991 as the Head of the Instrumental Enrichment Institute, I already had a great deal of experience teaching physics to students for matriculation exams, and was familiar with the long term goals of learning as required by the Ministry of Education in Israel. Students were expected to meet the national standards and succeed in solving the problems of the national matriculation test. Although my students were successful in these tests, I had the feeling that they did not learn how to think. They learnt how to cope with the demands of solving problems not very different from those of previous years. In hindsight, my teaching was too technical.

I remember the joy I had when I first experienced working with some pages of the IE Instrument, Organization of Dots. I realized then the power of short term mediation. Mediation enabled students to mentally approach or distance themselves from the cloud of dots presented in the task that represented reality (Feuerstein et al., 1997). The difficulties experienced by specific students were opportunities for me to listen to their dilemmas and to enable them to use cognitive strategies to find the geometrical figures hidden in the cloud of dots. The process was similar to finding a principle that can enable a student to organize an unknown environment. eReuven Feuerstein and the methods of Mediated Learning gave me a theoretical and practical approach that enabled me to understand, in a new way, the power of teaching and learning. The possibility to change cognitive performance through mediation opened my eyes to the possibility of using short term mediated interactions also in subject matter teachingThe MLE (Mediated Learning Experience) theory was very practical in relating to cognitive difficulties and mediation processes. How can it serve for meaningful teaching and learning of subject matter? The first step was to think of challenging teaching where students can benefit from mediated learning in subject matter learning. I chose to teach astronomy in a school for low functioning girls in the 9th grade (14 – 15 years old). Astronomy is considered to be a challenging subject and I asked myself how mediation could be used in its teaching.

Constructing understanding of subject matter

Teaching subject matter requires widening its theoretical background. Three aspects are considered:

1. The constructivist approach to conceptual understanding
2. Two levels of conceptual understanding
3. Creating "spaces of learning"

Relating to the three aspects above that effect subject matter learning:

1. The constructivist approach to conceptual understanding

In the late seventies and eighties of the last century a group of scholars recommended basing meaningful learning at any age on the principles of the vast studies of Piaget (Driver & Easely, 1978). As small children develop their understanding of the world on their active experiences, so do older students. Small children develop their conceptual understanding as they grow, and their conceptual development was studied in detail by Piaget. The constructivists' scholars studied the alternative concepts of students in relation to the scientific understanding of them. Thousands of studies were conducted. As good examples of a collection of studies of alternative concepts of students, one can quote two important books (Driver et al., 1985; Driver et al., 1994). Posner et al. (1982) defined meaningful learning as conceptual change.

2. Two levels of conceptual understanding

Carey (2009) in her monumental book "The Origin of Concepts", focused on the long and complex learning processes of little children immediately after birth. Some of the processes relate to the senses; others require disconnection from them in order to understand

theoretical frameworks. She articulates two levels of understanding that describe the learning of human beings throughout life, which are important in designing learning activities in the classroom:

a. Core cognition – Conceptual understanding that connects to the senses. The representation of a variety of environments that is done in iconic symbolic structures. For example, through learning language children improve their ability of observing and understanding reality around them. Children are able to observe environments in a new way through the use of categorizations of objects in colors, shapes, sizes etc., or by organizing events in space and time.
b. Alternative theories – Theoretical based understanding that requires disconnection from the senses, for example, the long and complex process of learning to count between the ages of 2 – 4.

3. Creating spaces of learning

In order to know something you have to compare it to other elements. Marton et al. (2004) describe a meeting between three people from Nepal that engage in a conversation. One of them was able to tell that the host spoke in a local dialect. The other two were unable to do so. The difference between them was the fact that only one of them knew other dialects of Nepalese. This means that an analysis of a situation requires being able to compare it to another one. In order to teach for understanding a concept or an object of learning, one has to compare between variations of them in different contexts. The art of teaching requires choosing meaningful environments that will allow a comparison between the variations. The definition of the concept is derived from the invariant representation of it that stays constant in the different contexts.

Uncertainty processes and the Thinking Journey (TJ) towards understanding

Thinking Journey (TJ) combines the above approaches with the MLE theory in order to enable students to experience meaningful learning. The above approaches design a map of the steps for learning for a student

to reach a scientific understanding of a concept (the object of learning). The student has to compare in order to understand a concept. She needs to move from her current alternative concept to another level of understanding, and combine her learning with her sensual perception of the world, or disconnect from it in order to understand a more theoretical analysis of the world. It is not enough to design the desired learning path, but it is necessary to enable students to experience learning and to listen to the wide range of constraints that typifies their learning in order to have a meaningful dialogue with them. The Thinking Journey (TJ) is focused on conceptual learning based on a mediated dialogue that is necessary in order to experience changes in their understanding of a learnt concept. Similar to small children, people of all ages require a process of going through a long and complex journey in quest of understanding. Mediation involves listening to the uncertainty processes that occur during the change processes of learners' experience in relation to the learnt concept. The dialogue can be designed in a series of unexpected mediated interactions that enable students to observe the learnt concept from multiple perspectives

Change processes are not easy for learners either in cognitive or subject matter learning. In the conceptual change process, as Nussbaum (1985) describes it, students have to go out of their current point of view of a certain environment. He claimed that conceptual changes require getting out of the egocentric point of view of the learner concerning the environment. In the process of change, students find themselves changing their initial concepts not knowing where this change will lead them. Learners have mixed feelings. They are confused and puzzled and sometimes ask themselves why they need to participate in a process that is not clear to them and at the same time are curious to meet new knowledge and understanding and discover new territories. The students' uncertainty processes relate to the emotional state of students during change processes. One can look at the point of view of the students from a wider perspective and relate also to the emotional side that effect their ability to change their level of functioning in the classroom. The way that they expressed their difficulties in their actions and words, was significant and important for the mediators to watch and learn. Each student had her own way of tackling new tasks. The uncertainty process that connects to change processes is an important factor in understanding where the student is in her learning, and in designing an approach for enabling her to tackle new learning challenges (Schur & Nevo, 2015).

Intertwined uncertainty and mediation

The basic relations between the mediator and the mediate require considering two contradicting processes that affect learning. On the one hand, there are the **goals of the teacher** and the means that the teacher uses in order to enable students to go through planned learning processes. Mediators set goals and give students cognitive tools that enable them to perform the required tasks, and reach new territories in their minds. On the other hand there are the **constraints that distance the learners from understanding the teaching goals**: the alternative conceptual understanding, the cognitive difficulties and the uncertainty processes. Students feel uncertain what to do and how to change. They feel remote even from knowledge that seems simple to the mediator. Classroom assignments require the learners to start a change process. However, as the learning continues, there is a need for empathy by the mediator towards the difficulties that students may encounter. The intertwining of mediation and uncertainty processes requires being at the same time assertive and sensitive, demanding and empathic.

The uncertainty processes appear during change processes. Whilst trying to tackle the demands of the task many students make efforts to conceal their lack of knowledge. They combine anxiety and curiosity in their feelings towards the new task. The Thinking Journey (TJ) approach allows an ongoing process to take place so that the mediator can listen to the uncertainty processes of the students in order to enable them connect the learnt concept with their worlds. Learning is constructed in a way that allows mediated interactions to occur. Learning is done in a series of mediated interactions, where the place of the learner changes and her point of

view of the learnt concept changes too. The journey's aim is to disconnect students from the regular places where they encounter the learnt concept, thus taking them out of their comfort zone and allowing them to be free from the difficulties of understanding because of constraints of their habitual way to relate to the learnt concept. Thinking Journey allows students to experience a journey in their minds, disconnected from the known contexts. Students experience unexpected encounters with the learnt concept. It is important to surprise them and enable them to have a new perspective on the concept in each mediated interaction.

A thinking journey to the moon

When I started working with 9th grade (14-15 years old) students on astronomy in 1993, I tried to combine Instrumental Enrichment tools with known programs for teaching the subject matter. However, students were not satisfied; they wanted to learn physics and not other things. They compared their own studies to that of friends in other schools, and complained that in their physics class they learnt other things, such as relevant pages of Feuerstein's programme for intervention, Instrumental Enrichment. It was an interesting lesson for me, one of many I was to learn from these students, that even students considered to be "low functioning", look for meaningful studies.

I understood that I had to integrate mediated interactions into the subject matter, the teaching of astronomy. I had to teach the content of subject matter whilst constructing a meaningful mediated dialogue in the classroom. I decided to use astronomical context as a means for the students to learn scientific concepts. Visiting remote environments in their minds could become a means by which students would see new connections between scientific concepts and phenomena. . It took me some time before I decided to use pictures and drawings as means to allow them to experience a journey in their minds to the moon and space. The aim of the journey was to enable them to observe the Earth from multiple perspectives and to compare it to the moon. In their minds, the students returned through the use of pictures, to Earth's environments and see them in a new way.

The mediated interactions were done through the journeys that students undertook in their minds through pictures. Look at the picture below, the Earth is seen from the moon (Picture 1). The sky of the moon is black. The Earth is in a phase, in a shape that resembles the way one can see the moon from the Earth's point of view. The ground of the moon is lit. It is daytime on the part of the moon that can be seen. This level of analysis relates to the "core cognition", and connects to seeing the details of the picture.

The picture caused a lot of excitement in the class. Students asked a lot of questions. In order to have a broader scientific understanding of the picture, we worked on "projection of relation", meaning relating to the experiences that students had and comparing them to the new phenomena that they saw on the moon. So, for instance it was like understanding how the Earth looks from the moon by knowing how the moon looks from the Earth. The phenomena of phases of Earth and that of the moon have the same scientific explanation, and they can be analyzed as light (day) and shadows (night). Another cognitive principle was "conservation of constancies", meaning that the same scientific principles can enable students to explain what they saw on the moon. The phenomenon look different from its appearance but the underlying principles are the same. For example, Astronauts walked on the moon in a different manner than the way people walk on Earth, because of its weaker gravity. For many students the existence of gravity on the moon came as a surprise. Moreover, its different appearance led some of them to say that it existed only on the top of the moon or that it can hold only heavy objects. The comparison between the Earth and the moon enables students to understand that the same scientific principles can lead to different appearances of phenomena, like that of the gravity on Earth and the moon or the different colors of the sky where for example, the sky seen from the moon is black, caused by the lack of air (atmosphere) on it.

Journey to new places

A thinking journey resembles a real journey in enabling students to get out of their known environments and discover new places. They can experience going to places

where human beings have not been or to places that are part of a literary reality. They can move in time and space in their minds. Arriving in a new place enables students to ask a lot of questions. Scientific principles that were seemingly clear in the known environments, like the nature of gravity or that of day- night cycle, seem unclear in the new environment. Are the same principles governing the reality also in the remote place? If a place is lit, does it mean that it is in day time? What is the nature of gravity on the moon? Students ask questions about phenomena that they thought they knew. It gives students the opportunity to make their understanding wider and deeper. The challenging environments enable students experience exciting processes of learning. The challenge involves uncertainty processes that are part of the need of students to find their way in unexpected environments and use scientific principles in an unknown environment. Mediation is important in order to make it a process of group effort of orientation in the new environments. Learning is a social phenomenon. A group of students is able to relate to complex ideas and to come up with creative ways of analysis.

The students liked the thinking journey to the moon, and they changed meaningfully both their understanding of the concept of Earth and their cognitive functioning (Schur, 1999; Schur et al., 2002). The results show the importance of enabling students get out of their egocentric point of view of a learnt concept and having enough time to learn about it through having some complimentary perspectives of it. At the same time, after repeating the learning process with many groups of students, and particularly when we started listening to uncertainty processes, we found that when students had to relate to the details of pictures like the one shown right, some university students also found it difficult to tell if the lit part of the Earth is in day time or at night (or if the ground on the moon is at day time or at night). Feeling a lack of knowledge when relating to pictures that show known places from an unusual perspective can cause students to feel lack of competence about the learning process they experience.

The same challenging assignment that enabled students to experience meaningful learning caused some to have feelings of confusion when confronted with unknown contexts. Thus, the uncertainty processes and meaningful learning go together. Mediated interactions enable students to get out of their comfort zone, which is a pre-requisite for learning for understanding, whilst at the same time, encountering emotional and cognitive difficulties in the process. The art of mediation is expressed in this challenging and complex process of learning for understanding.

Earth as seen from the moon

Research results

The experience of the astronomy classroom described above was the basis of writing a textbook "Thinking Journey to the Moon" (Schur, 1998; Schur & Orion, 2002) that was accepted as a part of the national curriculum for science teaching in middle schools in Israel. Another textbook used for the matriculation exams in high school followed: "A Thinking Journey to Mars" (Schur et al., 2002). A twelve-year research project followed in collaboration with Igal Galili, Head of the Science Teaching Department at The Hebrew University of Jerusalem, with the participation of students for doctorate and Masters Degrees. The research focused on the teaching of scientific concepts such as: weight and gravity, day-night cycle or life characteristics with a variety of populations of students. Some international research was done (Galili et al., 2012) and some articles were published: Schur &

Galili, 2009; Schur et al., 2009; Schwarz et al., 2011; Stein et al., 2014.

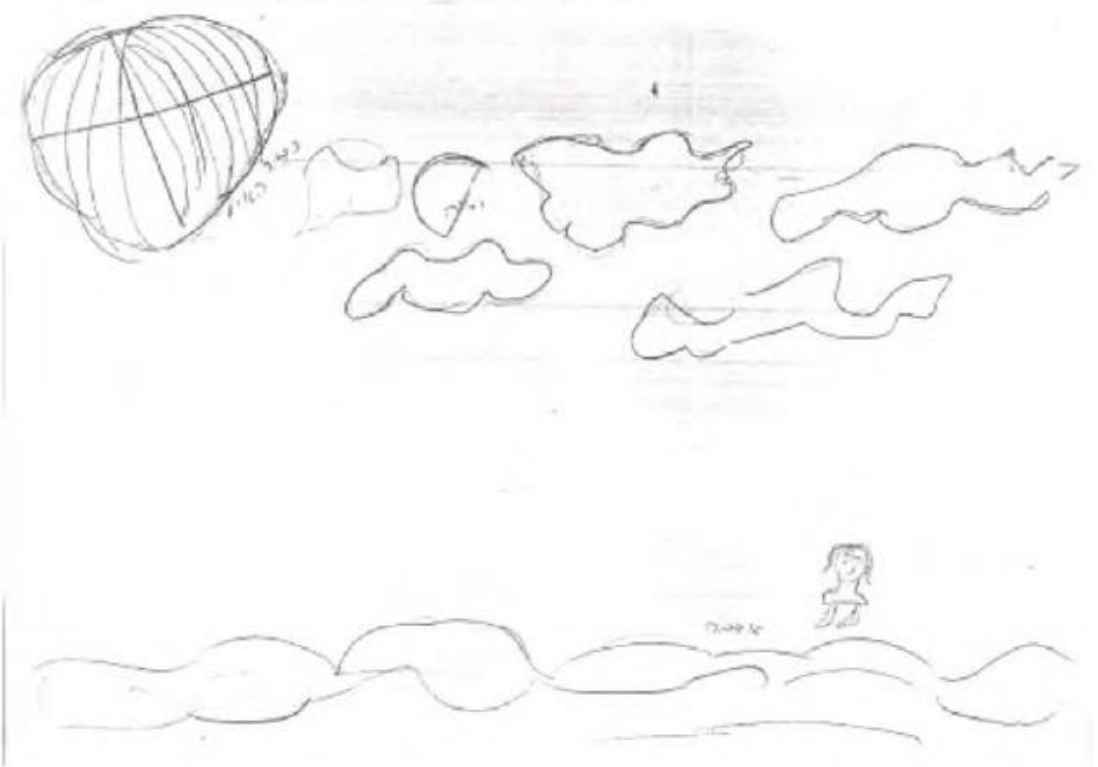
The learning experience of thinking journeys can be similarly applied in every subject matter. In many academic courses students construct thinking journeys in literature and history, in Religious Education and in mathematics, in computer sciences and in geography; with kindergarten students and with primary and high school classes.

A case study showing uncertainty processes and real conceptual learning

The following case study can show a meaningful conceptual change process and the uncertainty process that was involved. Tami (pseudo-name) was a new immigrant to Israel from Ethiopia. She learnt for a whole year about the Earth concept in Geography lessons. The process of her learning was described in two articles (Schur & Valanides, 2005; Schur, 2012). The student had difficulties of connecting herself to the Earth concept that was taught in the geography lessons. Her general feeling of detachment was meaningful in the way she functioned in the subject matter class. The globe was shown to the students as a means of representing the Earth during the lessons on it. Tami learnt many facts about the Earth, but she could not connect it to her own world. She put the Earth in the sky, claiming she has never seen it and never been on it. She drew the Earth in the sky with scientific information on it (longitudes and one latitude, maybe the equator). Near the Earth she drew the moon (she wrote Earth and moon in Hebrew near the drawings of them). She drew also the clouds. She explained that they hide the Earth. She drew herself standing above the ground. Her drawing can be connected to notion 1 of initial understanding of the concept of Earth (Nussbaum, 1985).

Mediation to Tami involved the use of picture 1 together with a picture of the astronaut Aldrin standing on the moon (Apollo 11). It did not add scientific information; as Tami showed quite a lot of knowledge, but was aimed at enabling her connect between her world and the concept of Earth. We asked her if places that she knew were connected to the unseen Earth. Israel was connected to it, meaning that it was not a place that

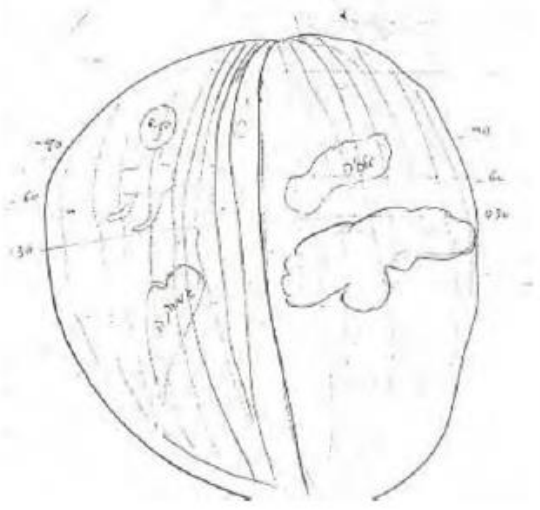
Earth is in the sky. Initial concept of Earth for Tami, a student from Ethiopian origin



Tami knew. But the city of Rehovot, where Tami lived, was the first real place that Tami was able to connect herself to in her near environment, but Tami was not able to understand that both she and the city of Rehovot was part of planet Earth.

Following mediation, Tami made a second drawing showing some connection between Tami and the Earth, but it was with the globe and not with the real Earth. She drew herself on the globe, near the continents of America and Asia (these are written in Hebrew). However, she disconnected herself from the ground. The globe appears to be a weird place on which to live, and it is not clear from her drawing how Tami held herself there.

At this stage, Tami felt that all the questions about the Earth were too much for her. She said: "I don't know why we need all these questions". Tami was on the highest point of confusion. On the one hand, she had made some connection between herself and the Earth - a new feeling for her - but on the other hand, it was not the real Earth she related to, but a globe in the sky with longitudes and latitudes. At this point she felt tired of the whole process and was ready to stop. Mediation was applied to encourage her to continue: *"It is in order for you to know where you live, where your house is"* we told her, to which Tami answered: *"I live on the ground"*. Her confusion was now over and she felt connected to the ground. On the ground, she felt secure. Her anxiety lessened.



Tami put herself on the globe, the representation of the Earth

At the end of the process we offered another comparison to the moon. From this comparison Tami deduced that people could stand on the moon in the same way that people stand on the planet Earth. She did not disconnect from the ground, but put herself on the ground of planet Earth. She drew herself again (drawing 3) which now clearly shows a conceptual change where she is seen to be standing on the ground of Earth. Her drawing is similar to Notion 2 of Nussbaum's '5 Notion description' of the Earth concept, leading to the scientific concept (Nussbam, 1985).

In conclusion, learning for Tami involved the need to overcome the pain of moving from her beloved Ethiopia to a very different country, Israel. Studying a scientific concept, the Earth, made her tackle her inner pain and she refused to connect the learnt knowledge with her own world. Her initial understanding of the Earth showed her refusal to connect to the learnt concept of the Earth. She learnt about it and knew some scientific information, but put the Earth in the sky. The mediation focused on possible connections between Tami and places where she lived and the Earth. The uncertainty process was at its highest point when Tami did her first step and connected herself to the globe. At this point she felt ready to stop the learning process. However as we showed her the initial pictures again, she had now different explanations to them. She could put herself inside the Earth through the comparison with being able to stand on the moon.

Brave teaching for understanding

Often teachers find it hard to disconnect from their point of view of the learning process. Their focus is usually on the content, the concept and its ingredients. Often this point of view makes it difficult for the teacher to connect with her students, because their alternative knowledge, cognitive and uncertainty processes take them to a very different point of view of the learnt concept. Teaching for understanding involves change processes of the students. It is not easy to change, and this applies also to the changes of conceptual understanding. Students have their own unique ways to resist to the changes, which we call uncertainty processes. Relating to uncertainty processes enables mediators to connect to the real worlds of students. The mediator should have empathy for the uncertainty processes that the learners go through.

In many knowledge exchange processes, both the teacher and the students stand on firm ground. There is no need to change, and the goals of teaching are very clear. But teaching for understanding requires the students to go out of their egocentric points of view and to experience change. The same challenging assignments enable students to experience meaningful learning and uncertainty processes, resisting the change processes and being attracted to it. Teaching for understanding requires being brave, because one has to take risks in order to enable students to get out of their comfort zone and to experience change processes. One can learn from Reuven Feuerstein the need to construct unexpected mediated interactions as a means to enable students to experience meaningful learning.

Thinking Journey is a means to enable students to understand concepts and for teachers to connect with students during the learning process. The journey itself enables the students to free themselves from the constraints of their known reality, of the difficulties of space and time that makes it hard for them to cope with the learnt concept. The journey is constructed from mediated interactions that are based on Feuerstein's MLE, that enable the mediator, the teacher, to have a meaningful dialogue with students in the class.

In teaching for understanding using the Thinking Journey method, one has to go through unexpected reactions, whilst at the same time give students a chance to reach out to new territories in their understanding.

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