

# Teaching the Concept of Time in Scientific Literacy with The Help of Transformative Learning Through Art in Adult Education

By

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## Abstract

*This paper studies the development of critical thinking and transformative learning through art (Kokkos, 2010, Mezirow and Associates, 1990). According to Freedman (2006) art is a way of connecting knowledge with emotion. The aesthetic experience can contribute to developing cognitive functions leading to the process of new knowledge and critical thinking (Brookfield, 2013). Transformative learning can be a powerful and empowering process that enhances personal growth, encourages critical thinking, and promotes positive change in individuals and communities. It allows individuals to develop a more nuanced understanding of themselves and the world, leading to greater empathy, tolerance, and social transformation.*

**Keywords:** *Adult Education, Science Literacy, Transformative Learning, Critical Thinking*

## Introduction

Transformative learning is a process of deep personal and cognitive change that challenges and transforms an individual's existing beliefs, perspectives, and assumptions. It involves critically examining one's own beliefs and assumptions, questioning the social and cultural norms, and reflecting on new experiences and information. The concept of transformative learning was introduced by Jack Mezirow, an educational theorist. According to Mezirow, transformative learning occurs when individuals undergo a significant shift in their mindset and worldview, resulting in personal growth and the ability to act and think in new and more inclusive ways.

Transformative learning is often triggered by a disorienting dilemma, which is an experience or event that challenges an individual's current understanding of themselves and the world around them. This can be a result of encountering new information, experiencing a crisis, or engaging in critical self-reflection. The process of transformative learning involves several stages. The first stage is becoming aware of the assumptions and beliefs that shape one's perspective. The second stage is critically reflecting on these assumptions and questioning their

validity. In the third stage, individuals consider alternative perspectives and seek to understand different points of view. The fourth stage is integrating new knowledge and perspectives into one's existing framework, making meaning of the experience, and developing new ways of thinking and acting. Transformative learning is not a linear process and can take time and effort. It requires openness, humility, and a willingness to challenge one's own beliefs and biases. It often involves engaging in dialogue with others, seeking diverse perspectives, and actively seeking out new experiences and information.

The object of teaching was the human perception of time. The concept of time is governed by relativity, something which we aimed to teach in a Second Chance School in Greece. The instructional objectives of the course were the demonstration of time relativity and the realization that time is an abstract concept that sometimes is not subject to the laws of linearity. To achieve our goals, we exploited artwork. According to Dewey (1980) aesthetic experience through contact with works of art, is a challenge for deeper thought and reflection. Perkins (1994) refers to the intelligent eye, believing that the contact of an observer with a work of art should not be just a simple observation but should be done in such a way that what is observed is afterwards being analyzed and conclusions are being generated. In this study we followed the Perkins method, which consists of six steps described in detail below.

In our study, while trying to define the concept of time and its relation to reality, we started the debate and encouraged the participants to try to identify the boundaries of time. That was the moment the first difficulties appeared. Time is not characterized by absoluteness, and it is not perceived in the same way by all people. The next step was the separation of learners into small groups, where they would record how they themselves understand the concept of time. Both the concept of linearity and relativity were found in their responses. This was followed by juxtaposition of different opinions, which converged in that time is not absolute, but there is relativity in the conception and perception of it. The conclusions that we reached were the non-linearity of time and the relative sense of time flow. The following questions we raised then:

- 1) Is there a case where time is not absolute and linear?
- 2) Do you have any personal experience in which you thought time passed too quickly or too slowly?

At this point we deemed it necessary to make use of some supervisory teaching media, to encourage our learners' critical thinking and imagination so that they could consolidate the subject to be taught more easily. After a few minutes of observation, they recorded their thoughts in groups and there followed a class discussion.

### **STAGE 1: Determination of the Need for A Critical Investigation of a Topic**

Time is a concept that we find in science too often. It is an abstract concept that can only be perceived by its flow. Nevertheless, we have constructed devices that count time, measuring something that we cannot determine what it is exactly. During the evolution of natural sciences, we observe a change of opinions concerning time. Most of us have an outdated notion that time is linear and absolute. That it starts somewhere and ends somewhere else in the distant future as a straight line.

This was the difficult everyday concept that we had to teach to the adult trainees in a Second Chance School in Greece. A diverse population of adults of varying ages, different religious beliefs, different nationalities and from different cultures. Our goal was to try to show them that time is relative.

### **STAGE 2: The Learners Record Their Opinions on A Matter, In the Form of An Exercise**

The next step was to divide the participants into two groups so that those that best handled the Greek language could help those that couldn't. Concerning the question: "How do you understand the concept of time?", the answers we got were that "time is something that flows from the past to present and to the future" and that "time passes sometimes faster and sometimes slower depending on situations experienced by the one who is measuring it. "

### **STAGE 3: Determination of the Critical Questions**

From the responses we got during the 2nd stage we concluded in a consolidated view of the absolute and linear time, while some evidence emerged that showed a relevance to feel the flow of time. Then we made a discussion with our learners about time perception that led us to the following two subjects:

- a) The non-linearity of time
- b) The sense of the flow of time

According to these subjects we addressed the following research questions:

- a) Is there a case where time is neither absolute nor linear? What is your opinion?
- b) Have you had any experiences in which you had the impression that time does not pass quickly or vice versa?

#### **STAGE 4: A) Selection of Artworks**

##### **B) Correlation of Projects with The Critical Questions**

At this stage we presented two paintings to our trainees, without revealing the titles or the names of the artists, an excerpt from a literary book and a clip from a movie. The artworks selected were related to our subject. Then we asked them to choose one or more and interact with them.

The projects were:

1. «The Time», Giovanni Rapiti, 2003 (painting)
2. «The Persistence of Memory», Salvador Dali, 1931 (painting)
3. "The Adventures of Alice in Wonderland» Lewis Carroll, 1865 (Alice's Adventures in Wonderland) (literary book)
4. «What the bleep do we know - down to the rabbit hole» William Arntz, 2004 (film)

#### **1ST WORK OF ART**



*Figure 1: Giovanni Rapiti «The Time», 2003*

(The painting is associated with a critical question: Is there a case where time is neither absolute nor linear? What is your opinion?)

In the first table the students turned their attention on the man who is trapped inside the hourglass, which measures time linearly, and therefore they focused on the fact that this is the way man has the sense of linear and absolute time. Also, they noticed that the hourglass is sailing, so is man, in the river shown in the painting.

## 2ND WORK OF ART



Figure 2: Salvador Dali «The Persistence of Memory», 193

(The painting is associated with the critical questions a: Is there a case where time is neither absolute nor linear? What is your opinion? And b: Have you had any experiences in which you had the impression that time does not pass quickly or vice versa?)

In this painting, the trainees commented on the melted clocks and related them with the relativity of time and the different sense of flow that each clock gives as an impression to the observer.

## 3RD WORK OF ART

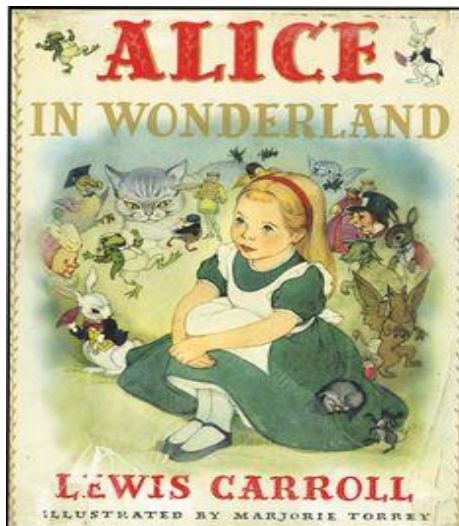


Figure 3: Lewis Carroll «Alice in Wonderland», 1865

(The literary in this text related to the critical questions a: Is there a case where time is neither absolute nor linear? What is your opinion? And b: Have you had any experiences in which you had the impression that time does not pass quickly or vice versa?)

This literary book is composed of 12 chapters—adventures of Alice in Wonderland. The instructor suggested a detachment of the 7th chapter-adventure, titled: "A tea for lunatics." In this adventure there is a debate over time, its measurement, its relevance, and its sense of flow.

The Hatter was the first to break the silence. 'What day of the month is it?' he said, turning to Alice: he had taken his watch out of his pocket, and was looking at it uneasily, shaking it every now and then, and holding it to his ear.

Alice considered a little, and then said, 'The fourth.'

'Two days wrong!' sighed the Hatter. 'I told you butter wouldn't suit the works!' he added looking angrily at the March Hare.

'It was the best butter,' the March Hare meekly replied.

'Yes, but some crumbs must have got in as well,' the Hatter grumbled: 'you shouldn't have put it in with the breadknife.'

The March Hare took the watch and looked at it gloomily: then he dipped it into his cup of tea and looked at it again: but he could think of nothing better to say than his first remark, 'It was the best butter, you know.'

Alice had been looking over his shoulder with some curiosity. 'What a funny watch!' she remarked. 'It tells the day of the month and doesn't tell what o'clock it is!'

'Why should it?' muttered the Hatter. 'Does your watch tell you what year it is?'

'Of course not,' Alice replied very readily: 'but that's because it stays the same year for such a long time together.'

'Which is just the case with mine,' said the Hatter.

Alice felt dreadfully puzzled. The Hatter's remark seemed to have no sort of meaning in it, and yet it was certainly English. 'I don't quite understand you,' she said, as politely as she could.

'The dormouse is asleep again,' said the Hatter, and he poured a little hot tea upon its nose.

The dormouse shook its head impatiently, and said, without opening its eyes, 'Of course, of course; just what I was going to remark myself.'

'Have you guessed the riddle yet?' the Hatter said, turning to Alice again.

'No, I give it up,' Alice replied: 'what's the answer?'

'I haven't the slightest idea,' said the Hatter.

'Nor I,' said the March Hare.

Alice sighed wearily. 'I think you might do something better with the time,' she said, 'than waste it in asking riddles that have no answers.'

'If you knew Time as well as I do,' said the Hatter, 'you wouldn't talk about wasting it. It's him.'

'I don't know what you mean,' said Alice.

'Of course, you don't!' the Hatter said, tossing his head contemptuously. 'I dare say you never even spoke to Time!'

'Perhaps not,' Alice cautiously replied: 'but I know I have to beat time when I learn music.'

'Ah! that accounts for it,' said the Hatter. 'He won't stand beating. Now, if you only kept on good terms with him, he'd do almost anything you liked with the clock. For instance, suppose it were nine o'clock in the morning, just the time to begin lessons: you'd only have to whisper a hint to Time, and round goes the clock in a twinkling! Half-past one, time for dinner!'

(I only wish it was,' the March Hare said to itself in a whisper.)

'That would be grand, certainly,' said Alice thoughtfully: 'but then—I shouldn't be hungry for it, you know.'

'Not at first, perhaps,' said the Hatter: 'but you could keep it to half-past one as long as you liked.'

'Is that the way you manage?' Alice asked.

The Hatter shook his head mournfully. 'Not I!' he replied. 'We quarreled last March—just before he went mad, you know—' (pointing with his teaspoon at the March Hare,) '—it was at the great concert given by the Queen of Hearts, and I had to sing.

"Twinkle, twinkle, little bat!

How I wonder what you're at!"

You know the song, perhaps?"

'I've heard something like it,' said Alice.

'It goes on, you know,' the Hatter continued, 'in this way: —

"Up above the world you fly,

Like a tea-tray in the sky.

Twinkle, twinkle—"

Here the Dormouse shook itself, and began singing in its sleep 'Twinkle, twinkle, twinkle,

twinkle—' and went on so long that they had to pinch it to make it stop.

'Well, I'd hardly finished the first verse,' said the Hatter, 'when the Queen jumped up and bawled out, "He's murdering the time! Off with his head!"'

'How dreadfully savage!' exclaimed Alice.

'And ever since that,' the Hatter went on in a mournful tone, 'he won't do a thing I ask! It's always six o'clock now.'

A bright idea came into Alice's head. 'Is that the reason so many tea-things are put out here?' she asked.

'Yes, that's it,' said the Hatter with a sigh: 'it's always tea-time, and we've no time to wash the things between whiles.'

'Then you keep moving round, I suppose?' said Alice.

'Exactly so,' said the Hatter: 'as the things get used up.'

'But what happens when you come to the beginning again?' Alice ventured to ask.

'Suppose we change the subject,' the March Hare interrupted, yawning. 'I'm getting tired of this. I vote for the young lady who tells us a story.'

'I'm afraid I don't know one,' said Alice, rather alarmed at the proposal.

#### 4TH WORK OF ART

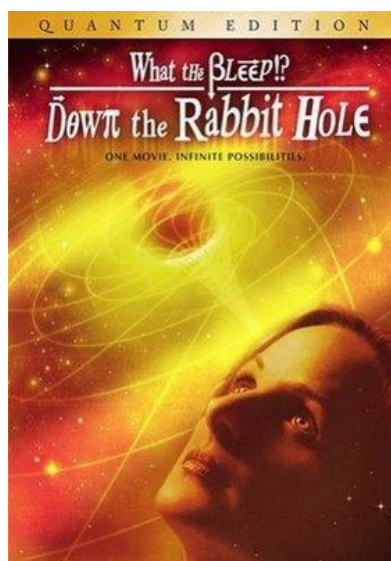


Figure 4: William Arntz «What the bleep do we know – down to the rabbit hole», 2004.



The movie clip can be found on the link below:

[https://www.youtube.com/watch?v=JsmqQ\\_NLa08&list=PLD70E913EDD127A7F](https://www.youtube.com/watch?v=JsmqQ_NLa08&list=PLD70E913EDD127A7F)

(The passage of this film was linked to the critical questions a: Is there a case where time is neither absolute nor linear? What is your opinion? And b: Have you had any experiences in which you had the impression that time does not pass quickly or vice versa?)

Trainees, watching the first 2 minutes and 15 seconds of the movie clip, wondered about the relevance and non-linearity of time.

Below is the correlation matrix between the projects and our critical questions:

*Table 1: Table of correlation between projects and research questions*

	WORKS OF ART	CRITICAL QUESTIONS	
		A	B
1	«The Time»	√	
2	«The Persistence of Memory»	√	√
3	«Alice’s Adventures in Wonderland»	√	√
4	«What the bleep do we know – down to the rabbit hole»	√	√

**STAGE 5: A) Interacting with The Artwork**

**B) Correlation of This Interaction with The Critical Questions**

a) In practice time we had at our disposal was not sufficient for the analysis and processing of all the supervisory media we used, so the trainees in consultation with the instructor chose one or some of them.

**1ST PROJECT - «The Time», Giovanni Rapiti, 2003 (painting)**

We treated this table based on the Perkins technique of four stages. In stage one we raised some questions of observation, like what they saw in the painting and what questions were created inside their minds, while the answers were being recorded. The responses received were that they saw an hourglass; a man in the hourglass, the hourglass was in a river, the hourglass was counting time.

The questions that emerged were:

1. Why was the man inside the hourglass?
2. Why did the hourglass seem to float in the water?

In the second stage, we asked our students to observe the painting in depth and state their views on the elements that made an impression on them. They were impressed by the fact that the man was inside the hourglass and not outside of it. They were also impressed by the fact that the man seemed to be trying to see something looking out of the hourglass.

In the third stage, i.e., the in-depth observation, we gave our students some information about the painting (title, date, etc.) and about the artist. A discussion ensued about the man in the hourglass, to interpret what it symbolized and what he was trying to see and why he was inside the hourglass and not outside of it. In addition, they tried to explain why the hourglass was sailing in the water.

In the fourth and final stage, i.e., in the review process, students were asked to rethink what had already been discussed.

## **2ND PROJECT - «The Persistence of Memory», Salvador Dali, 1931 (painting)**

This artwork was also analyzed with the Perkins four stage technique. Simply observing the table, the students reported that they saw melting watches, clocks located at different places, like on a tree or on a table, etc. Also, that the clocks had different dimensions and colors. In the background they observed the sea and a mountain. Many noticed that the red clock's indicators were difficult to distinguish. Finally, there was no human presence in the painting while distinguished elements from nature such as a tree, the sea and mountains exist.

During the in-depth observation, having revealed the project's title and the artist, we started a discussion to give meaning to what we observed. The trainees expressed diverse views, such as that the melted clocks probably symbolized the relevance and non-linearity of time. The absence of human presence from this painting was perhaps proof that time exists with or without it. Finally, in the review process we asked our learners to recap their thoughts and all that had been reported concerning the painting.

**3RD PROJECT - " Alice in Wonderland» Lewis Carroll, 1865 (literary book)**

We distributed roles to the students that wanted to participate, so each character mentioned in the part of the book that we had chosen was represented by a trainee, and then we asked them to read it aloud so that all participants could hear it. To edit the project, we chose the technique of Visible Thinking because it was shorter. We asked our students to describe what they heard, what happened in the story, but also about their considerations regarding the story. After some processing, ideas emerged about time probably not being linear and absolute, while the feeling that sometimes it passes slowly, and other times faster was mentioned.

**4TH PROJECT - «What the bleep do we know - down to the rabbit hole» William Arntz, 2004 (film)**

Watching the movie clip and focusing our learners' attention in the first two minutes and 15 seconds, using the technique of Visible Thinking, ideas emerged for relevancy and time perception by humans.

**b)** At this stage of the process, we asked the students to correlate the project analysis from above with the critical questions.

Regarding the first critical question (Is there a case where time is neither absolute nor linear? What is your opinion?), our participants, considering all the above, succeeded in seeing the concept of time from a broader perspective, which helped them to remotely escape from their stereotypical original position, namely that time is linear and absolute. Regarding the second critical question (Have you had any experiences in which you had the impression that time does not pass quickly or vice versa?), several personal experiences of the trainees were mentioned, who then, based on all the above, concluded that time is relative to each observer.

**STAGE 6: Critical Reflection**

At this stage of the process, "Transformative learning through Art" (Grain, 2010) asked participants to answer our original question again: "How do you understand the concept of time?" We found that their answers now were not as absolute and a faint suspicion of the subjectivity of time had already begun to emerge, depending on the observer. The whole process troubled learners and laid the foundations for further study since time is rather relative and probably not linear.

## **CONCLUSION**

We note that the use of art in teaching this difficult concept of time helped students to develop their critical thinking and probably led them to transformative learning.

The conclusions reached are that time is not as absolute as one would think. Almost everyone reported a personal experience, where he had the impression that the time was running out or had been frozen or stopped completely. There were some who said that they often have feelings of déjà-vu and that in some way time is flowing backwards. Everyone agreed that time gives us the impression that it is not linear and absolute, but there is variety in how it is experienced and perceived by people. Relevance, then, is the main feature of time and not absoluteness.

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