

## **Social Justice in Education of Non-Native Language Students: Teaching and Assessing in Science, Utilizing Transformative Learning Through Art**

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### **ABSTRACT**

**Aim:** The aim of the present study is to investigate the attitudes of science students regarding the transformative learning through art, in teaching and assessing knowledge.

**Study design and place:** The study was implemented within the Teaching Certificate course of the School of Science and Engineering, of the University of Crete. 63 students from the Departments of Biology, Physics, Chemistry, Mathematics and CSD were divided to groups and participated to experiential workshop, based on the theory of transformative learning, using visual art.

**Method:** Qualitative data was collected through students' answers in google form and was cross-referenced with researcher's observations and the reflection diary to reinforce reliability and objectivity. Two basic research questions were answered: a) Do you believe that the use of art supports the teaching of science to students who speak a language different from the one predominantly used at school? and b) Do you believe that you can assess the knowledge of students who speak a different language during instruction through visual arts?

**Results:** Regarding the first question, *all students responded that they believe that the utilization of visual arts is important for teaching science*. Thematic analysis of the responses revealed the factors through which this use influences the learning of non-native-language students: a) "experiential learning as supportive of science comprehension", b) "active participation of second-language learners in the group and sharing of ideas", c) "development of critical thinking," d) "creativity," e) "communication and social skills" , g) "empathy," h) "inclusion through teamwork and the application of multiple learning styles," i) "applying knowledge through representation in a way that promotes self-efficacy" and i) "activation of the Senses for Learning". Regarding the second question, which concerns the assessment of non-native language students through the use of visual arts, all students responded positively, stating that this approach can be used to assess students' knowledge. About half of them responded that assessment using this approach can be qualitative, as it overcomes language barriers, while the other half argued that assessing their knowledge through this approach can be used in addition to other existing assessment methods.

**Conclusion:** Concluding, this study confirmed the positive impact of transformative learning through art in teaching and assessing Sciences of Non-Native Language Students.

*Key words: Social Justice, Non-Native Language Students, Teaching and Assessing Sciences, Transformative Learning, Visual Art*

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### **I. INTRODUCTION**

Definitions of social justice have been proposed from legal, philosophical, financial, political, psychological, and educational perspectives. It is difficult to define it clearly, as it encompasses many different aspects. Social justice is essentially a phenomenon/situation that emphasizes the desire and effort to establish and maintain a society free from exploitation, violence, discrimination, racism, prejudice and marginalization. The goals include equal opportunities, the elimination of injustices, and the empowerment of all people with the objective of highlighting their potential and building social solidarity (Carlson, 2007). In education, the term has recently been utilized to boost educators' efforts toward social equality (Hyttén & Bettez, 2011), between different social classes, ethnicities, cultures and educational levels, as well as the abilities and disabilities of students in schools.

The demand for equal opportunities focuses on eliminating barriers to education and educational structures in general, by legitimizing the recognition of social diversity and human rights. Appropriate interventions aimed at challenging different interpretations of social reality regarding discrimination, with the aim of an education that utilizes theoretical tools to counter injustice, inequality, racism, and any other form of

discrimination. Social justice in education is linked to access to every aspect of the school system, to equal treatment within the school, and to educational systems that empower students socially and cognitively (Kar, 2015). As an educational institution, the school is institutionally designed to shape individuals with critical thinking skills and a sense of community (Hyttén & Bettez, 2011). On that basis, several approaches have been proposed that can offer opportunities for students' active participation as well as innovative approaches to education for all. One approach currently under investigation in the contemporary educational field—in this direction—regarding its outcomes concerns transformative learning through art (Nikkhah, 2011; Iyer-Raniga & Andamon, 2016; Şahin & Dogantay, 2018; Spanaki, 2023).

In recent years, social justice focusses on equal opportunities that promote inclusiveness in education through appropriate approaches to teaching diverse students. One of these approaches that has been frequently discussed over the past twenty years is transformative learning through art. Regarding the role of art in science education, several studies have been carried out. Nikkhah (2011) focused on the integration of art in teaching sciences, and he supports that it is one of the most effective approaches that can lead to the creation in teaching science. The arts include music, dance, drama, literature, cinema, etc., while the term "art" usually is referred to fine arts (painting, sculpture, etc.). Nikkhah (2011) believed that science education is possible to become more creative through artistic activities because of the optimization of science's information and knowledge. The transformation of that science information must develop through methodology and policies of Physical Sciences, promoting knowledge formation. Contemporary researchers (Şahin & Dogantay, 2018) argue that the theory of transformative learning works in a parallel way with critical thinking.

Spanaki (2023) investigated 42 science students' attitudes who studied at the University of Crete. They were divided into groups according to their discipline and participated to experiential workshops, based on the theory of transformative learning. Participants confirmed that peers' ideas, positive feelings and cooperation disposition motivated them to implement it. They were fascinated by the alternative way of teaching. They experienced interest, excitement and fun and they confirmed the importance of workshops through arts for their active learning.

At the same time, modern literature refers to Science, Technology, Engineering, and Mathematics (STEM) as a meta-science that connects applications across these scientific fields, with the aim of generating knowledge. International literature argues that the teaching of science, technology, engineering, and mathematics (STEM) requires more innovative and creative approaches (Guyotte et al., 2014). Thus, several scholars have proposed the integration of the arts into the teaching of Science, Technology, and Engineering as an important exploratory and creative tool, and have even recommended changing STEM to STEAM (Science, Technology, Engineering, Arts, Mathematics) (Liao, 2016). STEAM, where the "A" stands for Arts, is considered an interdisciplinary learning process that has the potential to increase the participation of diverse groups of students in STEM fields (Perignat & Katz-Buonincontro, 2019). Quigley et al. (2017), in order to develop a conceptual model of STEAM, reviewed the relevant literature on STEAM education. The 'Yackman' model easily integrates mathematics with science and technology and narrowly defines the arts as a method of inquiry and exploratory learning. Furthermore, it has been argued in the past that cognitive skills such as abstraction, analysis, synthesis, application, classification, perception, formulation, questioning, and interpretation are developed through interdisciplinary approaches and help students acquire multiple types of knowledge (Hetland & Winner, 2004; Liao, 2016; Root-Bernstein, 2015). In STEAM education, teachers foster problem-solving skills through the development of observation, understanding through experience, reflection, and reasoning (Liao, 2016).

Furthermore, the aspect of the approach related to interaction skills, including communication and collaboration, helps students, through brainstorming, to convey information, construct explanations, participate in discussions, disseminate knowledge, present, respond, and explain (Colucci-Gray et al., 2017). Through these processes, students convey their knowledge by communicating effectively and in a variety of ways, because of which they retain it in their memory for a longer period and apply it in new contexts (Rivet & Krajcik, 2008). STEAM education considers students' creativity to explore multiple aspects of a phenomenon or situation in various ways, including play, interpretation, modeling, and connecting ideas, with innovation supporting creative learning and idea generation (Kim & Park, 2012a).

Most researchers describe the STEAM approach as an integrated approach that encourages students to create within different learning settings, making their learning appear more dynamic and engaging. The arts serve as a means for developing ideas, discovering concepts, studying and exchanging thoughts (Sousa & Polecki, 2013). Stroud & Baines (2019) argued that integrating the arts into science education helps students who think and write to become creative and develop an interest in the subject rather than becoming bored while engaging with the sciences. As a result, the shift from STEM to STEAM is significant. According to Quigley et al. (2017), it is important for teachers to understand how they can manage diverse educational settings and incorporate the arts (STEAM) to teach a wide range of students, even in projects where they collaborate with one another.

This research project, which aims to study the impact of STEAM on the inclusion of non-native speaking students in order to promote social justice in schools, is also based on the researchers' proposal for teaching a diverse range of students.

Although its role in the inclusion of students with various characteristics is often mentioned, its role in intercultural education and the inclusion of non-native speakers has not been explored. This research paper is based on this aspect. Consequently, this study aims both to encourage the training of future teachers (including those in the sciences) in the STEAM approach (Quigley et al., 2017), as there is a lack of relevant knowledge (Henrike, 2017), as well as in the gap that appears to exist in the literature regarding the use of visual arts as a tool in science teaching. Furthermore, the gap in the inclusion of all students in science teaching appears to be widening in the field of intercultural education as well; therefore, this study focuses on the inclusion of students who speak other languages from the dominant one.

## II. METHODOLOGY

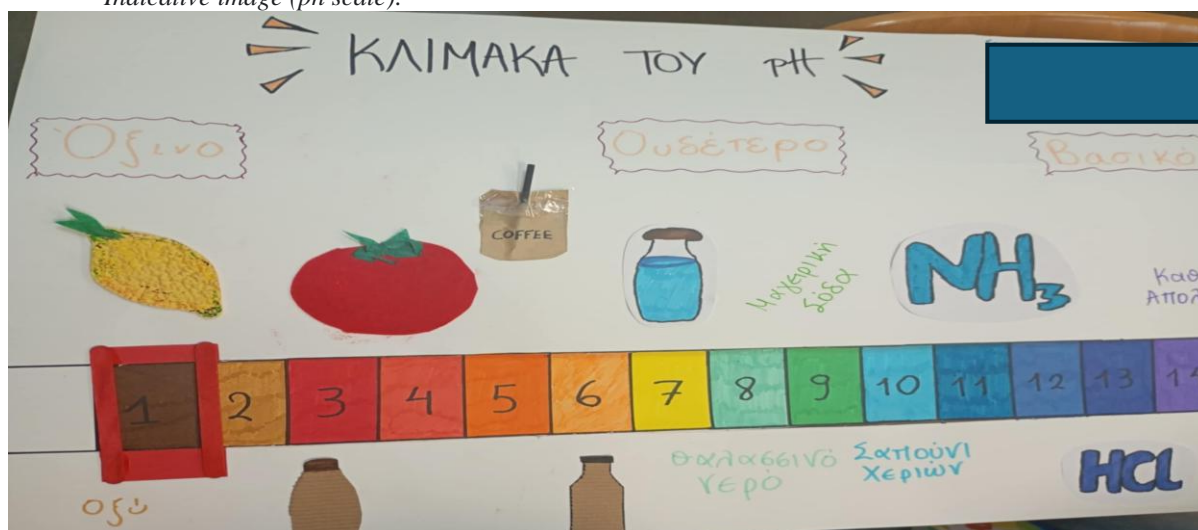
The present study is considered to be action research, also, more specifically a case study, because of its implementation at the University of Crete. Science and technology students participated in a particular workshop on the field of a pedagogical course, regarding the inclusion in education. The students participated in the Certificate of Pedagogical and Teaching Proficiency. Data analysis is supported by qualitative analysis, especially thematic analysis (Robson, 2010). A case study refers to a purposefully selected sample from a much more general sample group. This sample is used for a specific purpose, and the researchers take into consideration that the participants are being involved in a way that facilitates 'learning by doing' (Krain, 2016).

### *Aim sample procedure*

The aim of this case study was to investigate students' attitudes regarding the transformation of scientific knowledge to school knowledge through visual arts /aesthetic experience. Specifically, the study presents students' attitudes about transformative learning during teaching and assessing knowledge of science, mathematics or computer science.

The students must be involved in some way in a workshop and after completing the task, they should reflect on it and respond questions about the implementation. The sample was 63 students (34 boys, 29 girls) from the Departments of Biology, Physics, Chemistry, Mathematics and Computer Science who were divided into groups according to their discipline and participated in a workshop focused on transformative learning and assessing through visual arts, as part of the course during the winter semester of 2025. The participants were asked to be involved in teamwork negotiating a subject through secondary education books, and they used aesthetic approaches, like collage, painting and construction. Each group chose a topic, for example, the chemists chose «ph scale» while the biologists chose «physical selection». They deployed visual arts and recycled materials.

*Indicative image (ph scale):*



They presented their constructions to their classmates, and they discussed the knowledge that it offers to the learners and about their attitudes regarding the assessment that may provide. The lecturer and researcher and a CSD student performed the role of the observers, they received and collected photographic material and

wrote in a reflection diary. Subsequently, the participants were asked to fill out a google form with open-ended questions about their experience.

**Research tools**

The participants completed a google form with open questions. A CSD student’s observation during the workshop and researcher’s reflection diary, were also used to triangulate data. Data triangulation refers to the use of one or more methods of data collection and aims to increase validity and reliability in the qualitative method (Robson, 2010). Alongside, the researcher’s objectivity was ensured through her study of the relevant literature in-depth, which she was engaged and through the careful analysis of the data collected, so that she remained unaffected by prejudice and personal beliefs (Tsiolis, 2014).

**Data analysis**

Qualitative data was collected through students’ answers into google form and were cross-referenced with the observations and the reflection diary to reinforce reliability and objectivity. Overall, the responses were similar with many common elements for each tool, which have been used.

**RESULTS**

Regarding the first question, *all students responded that they believe that the utilization of visual arts is important for teaching science.* They focused on the above parameters:

<b>The Use of Art in Sciences for Teaching Students Who Speak Foreign Languages: Factors That Support It</b>	<b>Indicative Answers</b>
<i>Experiential learning and understanding for foreign-language learners</i>  References: 61/63	Experiential learning within a team of peers with different learning profiles and languages is particularly beneficial because it allows all students to actively participate through practical applications. By utilizing aesthetic experience and collaboration, language barriers can be reduced, making knowledge more accessible and understandable.
<i>Active participation of non-native speakers in the teamwork/sharing of ideas</i>  References: 60/63	Every student participates actively, even if the/she has different abilities or speaks different languages. Through group work, they learn better, share ideas, and gain a multifaceted understanding of the lesson.
<i>Developing Critical Thinking</i>  References: 52/63	They offer many ways to teach and learn (thus appealing to all types of intelligence) and foster the development of critical thinking. All of the above can be facilitated through experiential learning.
<i>Creativity</i>  References: 49/63	At the same time, it offers everyone an equal opportunity to showcase their abilities in many different ways, while fostering self-confidence and creativity—qualities that are often stifled by traditional teacher-centered learning.
<i>Communication / Social Skills</i>  Ratings: 45/63	Activities that combine art and science allow students to communicate without relying entirely on language, using primarily visual means to express themselves.... At the same time, participants harness their individual strengths and develop social and communication skills.
<i>Empathy</i>  References: 44/63	Students learn to consider a topic from different perspectives and develop empathy and teamwork skills.
<i>Inclusion/ teamwork / multiple learning styles</i>  References: 41/63	Experiential learning in diverse and varied groups is extremely useful and even essential, as it supports and reinforces highly important foundations, functions, and values, such as cooperation and inclusion, which are achieved through team-based learning and active participation, as well as multiple learning styles (e.g.,

<p><b>Applied knowledge/representation/self-efficacy</b></p> <p>References: 34/63</p>	<p>the use of visual aids)</p> <p>This type of learning functions as a deeply inclusive practice that not only recognizes but also capitalizes on individual differences. It makes scientific knowledge accessible to all students, enhancing their self-efficacy, engagement, and metacognitive development. For example, a student with limited language skills can understand a scientific principle through hands-on manipulation of materials and experimental inquiry, while a student with well-developed spatial intelligence can build the same understanding through models, maps, and visual representations.</p>
<p><b>Stimulating the senses for learning / corresponding to multiple types of intelligence</b></p> <p>References: 30/63</p>	<p>When students can learn through activities that allow them to engage in different senses (visual, auditory), learning becomes more comprehensive and personal. In teaching science, students have the opportunity to engage with concepts through their own experiences rather than solely through theory. At the same time, students with different types of intelligence can express themselves and better understand the concepts being taught by drawing on their personal strengths.</p>

Regarding the second research question: (b) do you believe that you can assess students' knowledge in a different language during arts-based instruction?

<p><b>A fully functional assessment of student knowledge</b> Reports 34/63</p>	<p><b>Assessment of knowledge as a supplement to other techniques</b> References 29/63</p>	<p><b>Methods of assessing knowledge</b></p>	<p><b>Further parameters which are evaluated through the use of art</b></p>
<p>1. The assessment of students' knowledge who speak a different language is not limited solely to traditional written or oral exams but includes the process of active participation in the creation, development, and presentation of the ideas they have grasped. <b><i>In fact, it allows for a more qualitative, creative, and formative approach to assessment. During an activity, students can be assessed on their understanding of a phenomenon or process (e.g., photosynthesis)</i></b></p>	<p>1. The only thing that cannot be assessed through art is the memorization of names, formulas, and dates, that is, the most specialized type of knowledge. <b><i>In short, art can be used to assess students' cognitive level, provided it is designed with clear instructional objectives and criteria and serves as a supplementary means of assessment.</i></b></p>	<p>1. <i>It is possible to assess students' knowledge with a different language during arts-based instruction.</i> Through oral and visual presentations and written work, students demonstrate what they have understood, without words...</p>	<p>1. The arts provide nonverbal means of expression. This allows students <i>to demonstrate their understanding of concepts and skills without relying solely on language.</i> Through <i>creative activities, students are given the opportunity to represent ideas, explain processes, or solve problems</i> in symbolic and practical ways, giving the teacher a clear picture of their knowledge.</p>
<p>2. Assessing students who speak a different language through the use of the arts is a pedagogically sound and</p>	<p>2. Students rephrase and explain their mathematical or scientific understanding through their artistic creations,</p>	<p>2. Art and construction serve <i>as evidence of an understanding of physical laws</i> (such as the density and mobility of</p>	<p>2. Through drawings, models, and other visual creations, students <i>visualize their knowledge, allowing teachers to</i></p>

<p>highly effective practice. Art, as a non-verbal form of expression, allows for the representation of students' understanding, thinking, and cognitive processes without requiring the use of written or spoken language. <b><i>The central role of art as a "language without borders" makes assessment possible through visual representations, theatrical performances, constructions, movement activities, or other forms of artistic expression.</i></b></p>	<p>rather than solely through the dominant language. <i>It is essential for the teacher to consider students' representation of knowledge and to use it positively in their overall assessment.</i></p>	<p>molecules) without the need for written language.</p> <p>3. "It is entirely possible and effective to assess students' knowledge in a different language through the arts. <i>Through a drawing, a collage, or a craft project, they demonstrate what they have understood without having to speak much or write complex answers.</i>"</p>	<p><i>assess their learning profiles</i> and enabling them to express what they have understood without having to speak. Thus, through this method, the teacher can assess students in general, and not just their knowledge.</p> <p>3. <i>Their collaboration (among peers) within the group is also assessed. This allows teachers to identify other aspects of their development and participation in school</i></p>
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### III. CONCLUSIONS

The participants of the present study unanimously agreed that transformative learning through visual arts and aesthetic experience is an approach to science education that offers opportunities for non-native-speaking students to develop both cognitively and socially, two parameters related to equal treatment in education, linking access to the educational system with social justice (Kar, 2015). 100% of participants responded positively to the first research question regarding the use of visual arts in teaching science to students whose language differs from the one predominantly spoken at school.

Thematic analysis of the responses revealed the factors through which this use influences the learning of non-native-language students: a) 61 out of 63 participants cited "experiential learning as supportive of science comprehension among students who speak a different language," b) 60/63 mentioned that this approach enhances "active participation of second-language learners in the group and the sharing of ideas" regarding the subject matter, c) 52/63 emphasized the "Development of critical thinking," d) 49/63 mentioned "Creativity," e) 45/63 referred to the development of "Communication and social skills" through the use of this approach, g) 44/63 mentioned the development of "Empathy," h) 41/63 emphasized "Inclusion through teamwork and the application of multiple learning styles," i) 34/63 mentioned the value of "Applying knowledge through representation in a way that promotes self-efficacy" among non-native speakers, and i) 30/63 emphasized the "Activation of the Senses for Learning," which concerns how each unique student learns according to the different type of intelligence to whom they belong

For the study participants, "different language or/and cultural background should not be barriers to learning but rather should reinforce the need for a more diverse and multidimensional approach." Their views are in line with those of researchers who advocate for the integration of the arts into STEM education (Spanaki, 2023; Stroud & Baines, 2019). Furthermore, science students highlight in their responses the need to provide opportunities and include all students, agreeing unanimously (100%) with social justice scholars who emphasize equal opportunities, the elimination of injustices, empowerment aimed at highlighting potential, and social equality and solidarity (Carlson, 2007; Hytten & Bettez, 2011).

Regarding the cognitive domain, the results of this study highlighted the value of experiential learning, which encourages students to actively participate in sharing ideas and knowledge related to the topic they are discussing in their group, which helps non-native speakers understand it. These findings are consistent with researchers who have emphasized the value of the STEAM approach in science education (Hetland & Winner, 2004; Liao, 2016; Quigley et al., 2017; Root-Bernstein, 2015, etc.). Furthermore, the participants in this study highlighted the development of critical thinking through transformative learning via art, in line with earlier research (Şahin & Dogantay, 2018) as well as the value of creativity in learning, which is also consistent with several researchers (Guyotte et al., 2014; Kim & Park, 2012a; Nikkhah 2011)

Furthermore, the results of this study emphasize the development of communication and social skills and are consistent with past research (Colucci-Gray et al., 2017; Rivet & Krajcik, 2008), which highlighted the importance of communication among students so that they can interact and share new knowledge with one another, without the need for an enriched vocabulary.

Nearly half of the science students emphasized the inclusion of students with individual differences in their learning profiles, who require multiple teaching methods to learn so that they can feel self-efficacy and be included in the classroom in ways that align with their personal expression and through practical means. Several researchers (Hetland & Winner, 2004; Liao, 2016; Root-Bernstein, 2015) have highlighted the importance of the STEAM approach and emphasized the value of inclusion through each student's personal expression, even through the practical application of their knowledge. Finally, the participants emphasized empathy, referring to a very significant aspect of social justice (Kar, 2015).

Regarding the second question, which concerns the assessment of non-native language students through the use of visual arts, all students responded positively, stating that this approach can be used to assess students' knowledge. About half of them responded that assessment using this approach can be qualitative, as it overcomes language barriers, while the other half argued that assessing their knowledge through this approach can be used in addition to other existing assessment methods. The originality of this research lies in the fact that the participating students reported that transformative learning through art operates through representations created on paper via drawing, where an understanding of the laws of physics and science is evident without the need for language or spoken or written discourse.

Additionally, the participating students highlighted other parameters that are assessed alongside students' knowledge. Representation through art demonstrates learners' creativity and provides insights into their learning profile. Furthermore, emphasis is placed on the visualization of knowledge, a parameter considered important in assessing students' acquired knowledge according to other studies on the subject (Guyotte et al., 2014; Nikkhah, 2011).

Overall, students highlighted interactive skills related to their cooperation with their peers. This dimension for interactive skills is thought to be significant because of the accordance with earlier researchers, who focused on importance and value of interactive and team - work skills in the learning process (Colucci-Gray et al., 2017),

Finally, taking into cognizance answers of google form, csd student' observations and the researchers' reflection diary notes, it seems that the most important references were:

*"Experiential learning serves as a catalyst for enhancing the participation of all students, especially when there are linguistic or cultural differences. Active engagement plays a catalytic role in fostering a deeper understanding of concepts while simultaneously promoting reflection, an element directly linked to Mezirow's principles of Transformative Learning. The latter emphasizes the importance of critically re-examining perceptions and generating new meanings, a process that is substantially enhanced when learning takes on an experiential character. Consequently, experiential learning is a decisive factor in shaping an inclusive, flexible, and pedagogically equitable teaching framework."*

*"Transformative learning, as a form of experiential learning in heterogeneous groups, is extremely useful, as it facilitates the exchange of experiences and fosters empathy. Students with different learning profiles are actively engaged, leveraging their abilities and learning from each other. The exchange of ideas, best practices, and skills does not necessarily require a common language, as the natural and technological sciences have a solid foundation in international scientific language and international symbols"*.

***"Drawing on Bloom's Taxonomy, this visual approach enables assessment at higher cognitive levels. Specifically, through the construction process, the student is not merely asked to define or describe (Level 1 – Know), but to create and synthesize (Level 6 – Create) a new model of response. The construction itself serves as proof that the student can organize and classify data (Level 4 – Analyze) as well as apply the rules of the subject to new situations (Level 3 – Apply). Consequently, the "language" of art transforms assessment from a test of memorization into a test of substantive critical and creative thinking."***

*"Assessment through the arts is functionally linked to the theory of Multiple Intelligences, allowing students to express themselves through their dominant cognitive style, whether it be visual-spatial, musical, kinesthetic, or interpersonal. At the same time, it aligns with the principles of Transformative Learning, as it encourages reflection and the creation of new meanings through creative processes. Consequently, assessment through the arts is not merely an alternative approach, but a scientifically and pedagogically well-founded practice, particularly useful for students with language difficulties."*

*"I believe that assessment through the arts can be an extremely effective, fair, and psychologically sensitive means of gauging the understanding of students with diverse linguistic backgrounds. Artistic expression—through painting, theater, music, creative movement, or crafting—provides these students with a non-language-dependent symbolic system through which they can externalize complex scientific concepts."*

To conclude, the present study is considered to be a case study, so there is an important limitation in the generalization of the results. However, it would be particularly useful to investigate students' attitudes from different science fields, as far as the use of transformative learning through visual art is concerned. It would be, also, useful to obtain information regarding the effect of transformative learning through art on the learning of students whose native language is different from the language of instruction at school.

#### IV. COMPETING INTERESTS

I 'd like disclose any financial and personal relationships with other people or organizations that could inappropriately influence (bias) the present process.

#### V. ACKNOWLEDGEMENTS

As a special education teacher, I am interested in new strategies and methods for teaching in future that will include all students, and through this project I wish to reinforce this idea among my students. Social Justice in Education of Non-Native Language Students is an essential topic for further investigation. But also I sincerely believe in effectiveness of teaching and assessing students utilizing Transformative Learning Through Art. Students have an important role to play in this process, and I thank them very much for this and for their honest opinions.

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