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Topic

Education and Learning in the Context of the New Normal: Sustainable Development and the Path to Sustainability

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Transdisciplinarity and Reflective and Creative Thinking through Art in Teacher Training

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Abstract: This article presents research on a creative and reflective thinking proposal conducted in the Early Childhood Education teaching degree program of the University of Valencia. The proposal was planned from a transdisciplinary perspective and combines art, technology and the Sustainable Development Goals from the 2030 Agenda. The study is linked to the Textile Cartographies international participatory project by the APECV (Association of Teachers of Expression and Visual Communication), in which 13 countries are involved. The research methodology is quantitative, using a validated questionnaire that helps evaluate the effectiveness of active transdisciplinary methodologies and art to promote reflective thinking. The total sample was composed of 117 students. The results of the questionnaire, which is structured into eight scales and a total of 48 items, reveal how activating reflective thinking leads to curiosity and surprise. This activation is driven by a transdisciplinary educational proposal which uses new technologies as a tool to create narratives and cartographies. In addition, importance is placed on cooperative group work, the contribution of ideas, and fostering creativity, giving value to experience for one's own professional future.

Keywords: transdisciplinarity; reflective thinking; teacher training

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1. Introduction

We are currently part of a society highly focused on the sense of sight [1,2] and which is not very reflective in terms of listening. The sense of hearing has moved into the background, resulting in a diminished appreciation for its value and importance, especially in the field of education [3]. If we take a look and analyze what is happening in classrooms, it is clear that the sense of sight is the one most relied on in educational processes. With this in mind, it is important to promote a new approach to education in schools that prioritizes the development of sensory awareness [4], specifically emphasizing the auditory sense and utilizing sound as a valuable educational tool [5]. This can be achieved through the implementation of "sound pedagogies", which are based on auditory learning processes and the creation of sound artifacts [6], which would help students develop higher perceptual qualities, improve comprehensibility of messages, and achieve a more complete processing. For this to happen and to achieve a stronger effect, it is essential to carry out this re-education in early childhood classrooms, and therefore in the training of future teachers, given that undergraduates will eventually be the ones impacted by this situation.

In teacher training, it is key to connect pedagogies to contemporary transmedia paradigms [7], as well as hybrid communication models that use digital audio [8]. This is why taking advantage of the potential of sonority, and its ability to allude to sound metaphorically or through sound propagation [9], is considered an opportunity to reflect on using technology creatively and in a situated way [10]. Approaching sonority in a creative and experimental way in the classroom [11] can offer insights that go beyond what

can be seen or spoken, allowing for multisensory dimensions and the exploration of one's imagination and projection of thoughts.

Teacher education has always been linked to critical and reflective thinking [12], and currently more emphasis is placed on the development of reflective skills: "21st century skills" [13], to help students grow and acquire professional skills [14]. This means betting on a different form of learning focused on the globality, interconnection, and operability of competences, generating reflective knowledge based on practice [15–17].

Developing reflective thinking involves several key elements, including the training of specific skills, the establishment of conducive learning environments, and the fostering of a thinking culture in the classroom [18–22]. That is why this research focuses on goal number 4 of the 2030 Agenda, which proclaims the importance of promoting inclusive and quality education and learning worldwide. More specifically, objective 4.7 of this goal emphasizes the need to promote sustainable development through education and to encourage a culture of peace, global citizenship, and sustainable development [23].

This article is framed in the research project "Transdisciplinarity and reflective–creative thinking in teacher training from a responsible perspective in the implementation of the sustainable development goals in the university", CIGE/049/2021 and 2022, from the call for "Emerging Projects GE-2022", Ministry of Innovation, Universitats, Ciència i Societat Digital, Generalitat Valenciana. The research aims to investigate the importance of transdisciplinary activities in promoting reflective thinking and learning processes, which will advance future teachers' professional skills [24]. Recent research suggests that transdisciplinary methodologies are useful tools that help students with reflective learning [25–27] and can be used to promote professional skills and development in university education.

In this project, we understand visual narrative methods as experiential and resonant personal stories constructed from the group. They are stories that are able to create a bridge between the academic curriculum and the development of both identity and the meaning of the constructed message. This connection enables the development of actions that are aligned with the sustainable development goals (SDG), and which promote practical and reflective knowledge on key aspects of daily life through a didactic art proposal. Teachers were committed to helping students consolidate theoretical knowledge and practical skills in order to enhance their ability to shape, adapt and transform abilities that are required to address the new realities of society [28]. In this way, the construction of embodied knowledge was possible through cartography and sonority [29], generating a space for personal reflection using stories provided through QR codes. These stories were used to connect the training and professional performance of teachers, (re)interpreting and (re)signifying the SDGs as a critical reflection strategy that seeks to promote sustainable societies.

Educational Intervention Proposal: Textile Cartography

The activity and the contextualization of its analysis is described below. The design of the educational intervention was carried out through an introduction to the theoretical–conceptual aspects of the APECV project, based on the Sustainable Development Goals of the United Nations' 2030 Agenda [30] and the acquisition of skills in the management of tools and processes in sound, visual, and artistic treatments. A learning situation was created according to the maieutic idea in which "knowledge is built collaboratively", encouraging students to generate the answers themselves [31] (p. 193).

The proposal was created to explore and learn about the impact of transdisciplinary methodologies to promote reflective thinking in the teaching–learning processes of participating students, as well as to develop their personal and professional skills through art. The principles that guide this pedagogical proposal, and therefore this research, are: (a) the use of artistic education with a transversal perspective, (b) the promotion of thought and experience to give meaning to student learning, (c) the promotion of a meaningful and community learning environment to encourage thought, and (d) awareness through art.

The intervention proposal was a community cartographic activity which was carried out at the Faculty of Teaching of the University of Valencia, in collaboration with students of the Early Childhood Education master's degree. Sound art tasks and textile cartography were combined. The proposal involved transdisciplinary work that favors reflective thinking, as well as the use of educational listening methodologies. To achieve this objective, technological, narrative and textile activities that connect with complex thinking and contemporary hybrid trends were carried out. The phases of the creative process are detailed below:

- Narrative: students choose a Sustainable Development Goal (2030 Agenda) to discuss and then write a story. They create a narrative relating to teacher performance by sharing a message of sustainability.
- Sound and Vision: students record the story with the Sodaphonic online tool and export it to an mp3 file. The sound wave image is captured using the Sonic Visualiser program and transferred to the cloth. Bragagnolo and Guigue [32] have used this program in their research methodologies to analyze the acoustic factors of the sonority of musical pieces.
- Textile cartography: work visuality and sonority. Students sew the sound wave onto a 10 × 10 cm cloth.
- Wordpress and QR: Students incorporate the audio story into a Wordpress web space and create a QR code that links to it. This content creation system in the classroom refers to the use of digital technologies to implement new teaching methods, known as ubiquitous learning [11].
- QR work: students print the QR code and then put it on the textile cartography that enables listening to the audio story with a mobile device.

The impact of the proposal was evaluated upon completion. The objective of this research was to design a pedagogical and artistic proposal and administer a questionnaire to collect the students' evaluation of the proposal's validity. Thus, the formulated hypothesis focuses on the fact that the development of this transdisciplinary artistic activity through the objectives of sustainable development [33] promotes reflective thinking in future early childhood education teachers. The research questions posed were the following: Does the designed activity encourage reflective thinking? What teaching aspects influence the development of reflective practice and what factors are involved? And what are the most developed reflective skills?

2. Materials and Methods

2.1. Study Design and Sample

A descriptive study with quantitative methodology was used, and although not an objective of this study, qualitative inquiry was carried out through discussion groups using the Padlet application. The sample consisted of 117 students enrolled in the 2022–2023 academic year. Students were in their third year of the Early Childhood Education teaching degree at the University of Valencia. Regarding gender, a predominance of women over men was observed (specifically, 88.5% compared to 11.5%). Sampling was convenience/intentional, and students enrolled in the Arts and Visual Education course from the Early Childhood Education degree were asked for their voluntary and anonymous collaboration. No student was excluded for reasons of age, gender, disability, or special educational needs, and the diversity of the group was respected. This research study was approved by the Ethics Committee of the University of Valencia and professors were responsible for designing and applying the intervention proposal as well as administering the questionnaire.

2.2. Instrument and Variables

Student data were collected using a self-administered questionnaire. This instrument collected the students' perceptions on the value of the "Textile–sound cartography" proposal using the sustainable development goals approach. The questionnaire that was used

was the "Questionnaire on narrative approaches for promoting reflective thinking in higher education (initial)". It is composed of 48 items grouped into 8 scales. It is worth mentioning a slight modification of the items in the validated reference questionnaire [34]. In dimension 1, five items were identified and not seven as in the original source, and in dimension 3 two items were added to the scale. The items are answered using a Likert-type scale with numerical values from 1 to 5, with 1 being the lowest value (never) and 5 the highest (always). This is a validated questionnaire, with the Cronbach's alpha for each of the 8 scales being 0.966 [34].

2.3. Procedure

First, contact with the students, the potential research participants, was made through the professors of the course mentioned above. After this first interaction, students interested in participating were provided with the questionnaire, which included informed consent and the purpose of the study. Finally, the Google Forms application was used to complete the questionnaire. According to Nunnaly [35], self-report scales or questionnaires have limitations and disadvantages when used for educational evaluations. However, they constitute one of the best possible approaches. The measurement instrument has good psychometric properties, given that it is adapted and validated in a similar study population [34]. It is used to evaluate and is sensitive to changes in its dimensions [36]. This procedure was carried out in the second quarter of the 2022–2023 academic year.

2.4. Statistical Analysis

The analysis was performed using the SPSS 26.0 program (IBM Statistical Package for the Social Sciences, Armonk, NY, USA) licensed by the University of Valencia. The responses obtained through the questionnaire using Google Forms were transferred to an Excel spreadsheet that was later exported to SPSS, allowing a reliability analysis of the internal consistency of the scales using Cronbach's alpha.

2.5. Ethical Considerations

This research has the approval of the University of Valencia Ethics Committee. Free participation with the corresponding informed consent was requested, and adequate treatment of the information collected was guaranteed.

3. Results and Discussion

The results extracted from the questionnaire, which was applied to assess the reflective and creative thinking of the sound art transdisciplinary proposal using the sustainable development goals approach (Textile Cartography/Sound SDG), are described below.

First of all, it should be noted that the average age of the participating sample was 22.11 (SD = 2.88), with an age range from 19 to 37 years. A total of 110 participants were women (94.01%) and 7 men (5.99%). The latent variables of the questionnaire indicate response values between 1 and 5 and the questionnaire has a total of 48 items. The items' mean value oscillates between a maximum of 4.49 for the variable "create an environment of trust in the classroom" and a minimum of 2.60 for the item "when I was working on the proposed tasks, I was able to do it without thinking about what I was doing". The responses to the variables are found within the values of the standard deviation, except for 9 items out of 48. These nine items have standard deviation values ranging from 1.017 to 1.137. The Cronbach's alpha for the questionnaire was 0.942 and the Cronbach's alpha based on standardized items was 0.942.

Table 1 illustrates the emotional dimension of the students when carrying out the activity. Through mean value interpretation (on a Likert scale from 1 to 5) we observe that it elicited high levels of curiosity, enthusiasm, and surprise. It should be noted that, despite the fact that they felt confident, students also felt confused about the activity. With regard to the standard deviation >1, it indicates a certain deviation of the data, although in no case is it greater than the average.

Table 1. Statistical values of scale 1 of the questionnaire: "Feelings of the students when carrying out the tasks".

Items	Mean	Deviation
1.1. Curiosity	4.31	0.825
1.2. Enthusiasm	3.95	0.849
1.3. Surprise	4.09	0.982
1.4. Confidence	3.26	0.941
1.5. Confusion	3.30	1.085

Source: Own elaboration, 2022.

Next, Table 2 shows the reflective skills developed from the sound art transdisciplinary proposal. The mean values obtained in all the answers are high (between 3.70 and 4.28), with a standard deviation in all items <1, so it can be concluded that the activity fosters reflective thinking skills and processes in the students' learning.

Table 2. Statistical values of scale 2 of the questionnaire: "Developed reflective skills".

Items	Mean	Deviation
2.1. Reflect on the meaning of what I learn	3.98	0.820
2.2. Argue and question what I am learning	3.89	0.879
2.3. Be aware of how to transfer what I am learning to my future professional practice or alternative spaces (internship or other subjects)	3.97	0.914
2.4. Connect knowledge with my own experiences, emotions, and attitudes	3.94	0.854
2.5. Learn from myself, from what I already know	4.02	0.910
2.6. Enrich my ideas with the contributions of others	4.28	0.775
2.7. Position myself on the covered topics in readings, class lectures and the point of view of others (debates and group work)	3.70	0.854

Source: Own elaboration, 2022.

Table 3 shows the results of the students' perception and awareness of the proposal's own learning process. The usual deviation is between 0.842 and 1.119, which indicates that there is greater dispersion in the responses of some of the items.

Table 3. Statistical values of scale 3 of the questionnaire: "Levels of reflective thinking".

Items	Mean	Deviation
3.1. When I was working on the proposed tasks, I was able to do it without thinking about what I was doing.	2.60	1.091
3.2. The proposed tasks forced us to understand the content that was taught.	3.78	0.842
3.3. The tasks proposed in the subject have made me change the way I look at myself.	2.89	1.049
3.4. In this subject we have done the tasks so many times that in the end I have managed to do them without thinking too much.	2.67	1.017
3.5. To pass the proposed tasks it was necessary to understand the content.	3.98	0.947
3.6. The tasks proposed in the course have questioned some of my most fixed ideas.	2.76	1.119
3.7. In the proposed tasks, as long as the content worked on could be remembered, I did not have to think too much.	2.91	0.906
3.8. I needed to understand the content worked on in class to carry out the proposed tasks.	3.65	0.977
3.9. The proposed tasks have changed my usual way of doing things.	2.84	1.066
3.10. If I followed what was said/asked, I did not need to think too much to carry out the proposed tasks.	3.17	0.985
3.11. In the proposed tasks I had to continually think about the content that I was being taught.	3.21	0.952
3.12. During these tasks I have discovered weaknesses that I was unaware of before.	3.46	1.111

Source: Own elaboration, 2022.

The results show that the highest values are obtained by the statements which address the need to understand the content (3.78–3.98–3.65), which confirms that activities within

transdisciplinary methodologies require greater effort but are still accessible and can be assimilated.

The data obtained from other items provide information on students' perception of this type of activity (2.89–2.76–2.84–3.46), which leads us to consider the importance of regularly implementing transdisciplinary methodologies, to detect the competence weaknesses of the students and provoke questioning of their ideas and previous conceptions.

Finally, the data of the four items that are formulated indirectly (2.60–2.67–2.91–3.21), reinforce the idea that tasks that are outside of the students' comfort zones encourage them to reflect, think and follow instructions.

The analysis of students' awareness of the learning process can be found in Table 4. Interpreting the mean values, we can conclude that this educational experience emphasizes creativity and individual effort (4.26–4.16). It also requires students to actively search for and provide solutions, encouraging greater involvement in their work (4.15–4.21). Likewise, the students recognize, with high scores, the need to persevere and plan the work in order to carry out a successful learning process (4.06–3.96). It should be noted that the standard deviations of all items were <1.

Table 4. Statistical values of scale 4 of the questionnaire: "Learning process: autonomy and reflective self-awareness".

Items	Mean	Deviation
4.1. Know how to plan my work independently	3.96	0.986
4.2. Be more persevering when doing work and learning	4.06	0.922
4.3. Be more creative to solve my difficulties	4.26	0.892
4.4. Try harder to learn by myself	4.16	0.956
4.5. Have a greater involvement in my work	4.21	0.869
4.6. Apply solutions to solve the questions that I have	4.15	0.903

Source: Own elaboration, 2022.

Table 5 portrays the students' opinions regarding how transdisciplinary tasks and reflective thinking have allowed them to develop their training competency. The results are very positive, given that the means of all its items are between 3.82–4.53, and the standard deviation is, except for one item, <1. These data lead us to recognize the effectiveness of these methodologies when it comes to raising awareness among students about their competences, both at a student level and in their professional future, as well as to help detect their limitations and personal strengths. Other high averages are linked to the recognition of teamwork for better learning (4.53), and placing value on the communication potential of storytelling (4.27), which can be an important tool to improve their communication competence as a future education professional.

Table 5. Statistical values of scale 5 of the questionnaire: "Awareness of their own learning".

Items	Mean	Deviation
5.1. Become aware of what I have to improve professionally and/or as a student	3.82	1.022
5.2. Better understand the complexity of my future professional practice	3.97	0.923
5.3. Reflect to get to know myself better as a future professional	3.93	0.953
5.4. Become aware of my difficulties in the learning process	4.03	0.866
5.5. Know my strengths in the learning process	4.13	0.856
5.6. Give value to storytelling (oral, written, and visual) to communicate	4.27	0.877
5.7. Recognize teamwork for better learning	4.53	0.651
5.8. Become aware of how I learn	4.10	0.894

Source: Own elaboration, 2022.

The analysis of Table 6 reveals the students' assessment of the teaching staff's role, which received high scores. It shows the importance of generating a meaningful and community-based learning environment in which students can act independently (4.49–4.28–4.12), but with time for group reflection (4.25). This requires teachers to provide clear instructions for carrying out the activity correctly, as well as giving constructive feedback throughout the learning process (4.09–3.67).

Table 6. Statistical values of scale 6 of the questionnaire: "The role of the teacher".

Items	Mean	Deviation
6.1. Facilitate clear instructions	4.09	0.925
6.2. Give constructive feedback on work done	3.67	1.137
6.3. Help me think and ask questions	4.12	0.832
6.4. Create an environment of trust in the classroom	4.49	0.715
6.5. Provide spaces to expand and develop ideas with others (in interactions and through group discussion)	4.25	0.765
6.6. Allow me to act independently	4.28	0.797

Source: Own elaboration, 2022.

Table 7 shows the high score (4.19) attributed to learning that connects theory and practice through experience.

Table 7. Statistical values of scale 7 of the questionnaire: "Connection of theory and practice in learning and experience".

Item	Mean	Deviation
7.1. Learn by connecting theory with practice and one's own experience	4.19	0.798

Source: Own elaboration, 2022.

To conclude the analysis, the results in Table 8 display high averages (4.21–4.05–3.99), indicating that the implementation of a transdisciplinary methodology that incorporates reflective thinking in teacher training is suitable for achieving the learning objectives and developing skills that can be applied in their future professional life.

Table 8. Statistical values of scale 8 of the questionnaire: "Innovation and adaptation to the objectives and teaching competences".

Items	Mean	Deviation
8.1. The novelty of storytelling to express myself	4.21	0.797
8.2. The relevance of completing the learning objectives of the subject	4.05	0.741
8.3. Suitability for my future professional skills	3.99	0.749

Source: Own elaboration, 2022.

In summary, the findings highlight that reflective practice, as expressed by [37] implies:

- Recognition of personal skills
- Individual contribution to practice
- Recognition of theory–practice integration
- Development of levels of reflection
- Review of learning derived from pedagogical practice

Transdisciplinary educational practices involve thought and planned actions to ensure experimentation, reflection, and action; that is, a link between theory and practice, with a look at an education that problematizes reality [38]. The aim of this study was to create a proposal that reflects how the needs of both the teacher and the learner must be met.

In addition, it is shown that through the reflective and critical analysis of their own practice, teachers in training demonstrate the competences needed to enrich their lives

and professional experience [39]. This also promotes the groundwork for future encounters between theory and practice, ensuring the development and professional growth of teachers.

4. Conclusions

Designing an activity based on reflective transdisciplinary teaching practices that is well received is a challenge. However, the importance of teachers' points of view and the potential of these proposals to develop critical thinking in university students is key if we want to improve teaching and promote innovation and change (Schendel, 2016, cited by [40]).

In this sense, Sound–Visual Cartography that develops narratives on social aspects, such as the SDGs, based on collective thought, reinforces the initial idea that they are possible and necessary in university education, and above all, in the acquisition of knowledge through integration processes and creative activities framed within transdisciplinary frameworks [41]. After analyzing the results of the questionnaire that collects the students' assessment of the educational proposal, and answering the research questions as well as the hypothesis, the study corroborates the validity of this practice and recommends it as a viable methodology. "Cartography is presented as a useful tool for the evaluation of ephemeral processual experiences of students such as dérive or other learning processes" [42] (p. 383).

This study has verified that promoting cartographic sound and visual narratives in the learning process has multiple benefits, for both individuals and groups. The following contributions were selected from the extracted data:

(a) It elicits great curiosity and surprise and helps students enrich their ideas with the contributions of others, as well as learn independently from previous knowledge.
(b) It helps students be more creative when it comes to solving problems and encourages greater involvement and effort in the development of their work.
(c) It helps students be more aware of the difficulties throughout the learning process and understand their weaknesses and strengths, which implies greater awareness of how one learns.
(d) The activity affects "sound pedagogies" [6] that bring students closer to novel theoretical–practical experiences with acoustic media, sound representations and digital listening environments [11], helping them overcome the initial confusion and implement solutions [34].
(e) It offers students the opportunity to extend their thinking, and connect to sustainability problems (SDG), by analyzing what is happening, but also by going deeper, given that it allows them to interpret and give meaning to new thoughts.
(f) The activity promotes situations of social learning through art, favoring relationships between teachers and students when it comes to understanding the global emergency situation, while raising awareness about their future work as teachers.
(g) It incorporates the contextual and emotional dimensions that are key to the practice and development of reflective thinking.
(h) The use of the Padlet application as a tool for discussion and synthesis facilitates feedback and reflection, promoting learning. It has been proven to be an effective strategy to improve self-regulated learning.

Other aspects that were evaluated point out how teachers must create an environment of positive trust in the classroom, as well as allocate time and space within their teaching schedule to expand and develop ideas, both individually and in groups, without forgetting the group discussions as a synthesis tool at the end of the educational proposal. Therefore, the idea of Martínez-Sanz (2022) [43] is reinforced:

"Active methodologies, such as cooperative learning, allow the three mentioned components to be combined in its execution, simultaneously contributing to the acquisition of knowledge; to the exercise and consolidation of powers; and the awareness of responsibility" (p. 4).

This study has helped us to demonstrate and understand, as corroborated by data, that transdisciplinary methodologies using art show the suitability and strength of both oral, written, or visual storytelling to communicate, hence the importance of sonority and listening as a key part of both university and school education. As indicated by research and the high scores attributed by the students, this type of practice allows learning to happen by connecting theory with practice and with one's own experience, which leads us to place value on the importance of promoting multisensory learning through art and, specifically, sound art. It is worth noting the importance of clearly establishing the learning objectives, so that the students are aware of the expectations of the activity [44].

It is clear that there are increasing demands at a pedagogical level, and that teachers who propose and develop transversal projects have more tasks to carry out. This is because these projects consist of activities such as reviewing one's own practice and workshops, creating group and individual dynamics, developing educational guidelines, curricular development, participation in institutional activities, etc. Transversality requires greater attention and effort on behalf of teachers, as they strive to innovate in the teaching–learning processes of the 21st century. This entails creating learning environments and implementing knowledge related to sustainable development goals, technology, and the arts, all of which facilitate critical analysis of societal aspects [45].

In this study, the curriculum has an implicit purpose that addresses the understanding of reality and the ethical commitment of each and every teacher in training to transform education and make it more fair, sensitive, and democratic through active methodologies that are based on experience and practical learning [46].

The design of this sound art transdisciplinary proposal, which incorporates storytelling based on the Sustainable Development Goals (SDGs), is a new and innovative approach for students to express themselves. It is also beneficial in helping them achieve their learning objectives by equipping them with contemporary professional skills. "This also puts us in a position to understand how the problems and perspectives of each student, when presenting themselves to others in the public mediation environment that classrooms represent, significantly configure the perception and relationship they have with the environment they are faced with and their overcomings, internal struggles and fears" [47] (p. 525).

In addition, students who use art transdisciplinary methodologies perceive that the project does not just rely on one single point of view [48], and learning is understood as the acquisition of knowledge through integration procedures with creative activities [41], and the richness of group contributions. Finally, it configures the role of teachers as 'guides and facilitators' who support and nurture their students through the process of thinking, reflecting and listening, with the aim of raising awareness and motivating their actions through education for a more sustainable world.

And finally, it is worth mentioning that it is essential to evolve and enrich university education so that future education professionals change their practices to accommodate the realities of school classrooms. Art enables the critical spirit to be activated and strengthened, and its potentialities developed, as well as to convert the difficulties of the students into opportunities and therefore deploy new ways of educating in our contemporary society [49]. Art as a medium for listening offers creative and innovative transdisciplinary narratives in line with contemporary paradigms influenced by digital culture and new models of symbolization and socialization.

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