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# Identification of Levels of Sustainable Consciousness of Teachers in Training through an E-Portfolio

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**Abstract:** The contents of Education for Sustainable Development should be included in teachers' initial and advanced training programs. A sustainable consciousness is one of the main foundations for determining the key competences for sustainability. However, there are not many empirical studies that deal with consciousness from education. In this context, the e-portfolio appears as a tool that promotes reflection and critical thinking, which are key competences for consciousness development. This work intends to propose a categorization system to extract types of consciousness and identify the levels of consciousness of teachers in training. For this research work, which is of an eminently qualitative nature, we have selected 25 e-portfolios of students (teachers in pre-service training) in the last year of the School of Education at the University of Macerata (Italy). The qualitative methodological procedure that was followed enabled deducing three bases that shape the consciousness of teachers in training: thinking, representation of reality, and type of consciousness. We concluded that the attainment of a sustainable consciousness in teachers requires activating and developing higher levels of thinking, as well as a projective and macrostructural representation of reality.

**Keywords:** sustainability; consciousness; education; e-portfolios; ICT

## 1. Introduction

Today's dominant approach on Education for Sustainable Development has been carved in the last two decades under UNESCO's leadership. Specifically, its Global Action Program (GAP) for Sustainable Development, regarding Education (Sustainable Development Goal Four, or SDG 4), intends to develop two clear objectives: (1) reorienting education and learning so that everyone has the opportunity to acquire knowledge, skills, values, and attitudes to empower them to contribute to a sustainable future; and (2) strengthening education and learning in all agendas, programs, and activities in order to promote Sustainable Development [1] (p. 18).

In addition, the declaration of the Decade of Education for Sustainable Development (ESD) (2004–2015) reveals that the progress toward Sustainable Development requires establishing action frameworks to encourage civic participation, awareness, education, and qualification [2,3]. Education has been regarded to play an essential role in this process, as it is the foundation to build more sustainable and equitable future scenarios. In this regard, teacher training institutions are key agents, and for these reasons, UNESCO [4–6] has recommended that nations include such institutions in their plans for national sustainability.

Therefore, we need to integrate ESD in teachers' initial and advanced training programs; but also, in order to do research on suitable pedagogical practices in order to help teachers formulate ESD strategies applicable to teaching and evaluation of ESD learning processes [7].

On the other hand, there is a long and extensive research line on the use of ICT in schools and its effects on learning. Some of the results point out that ICT tools promote both students' learning and motivation and have a great value and potential to encourage inclusion [8–16]. That is why integrating ICT in teaching methodologies is so relevant for teachers' training to achieve sustainability goals.

However, still there are unanswered questions subject to research, such as: what teaching competences for sustainability should be developed during teachers' initial training? What didactic methodologies are more suitable for this purpose? What role should ICT play in the development of sustainability competences?

In short, if sustainability is one of these essential challenges of today's society for the years to come, we need to provide educational agents, mainly teachers, with competences that encourage Education for Sustainability at different educational levels and contexts. In this line, our purpose is to explore the e-portfolio in sustainability awareness learning and assessment in teachers' initial training.

The building of the sustainable consciousness of the citizens is the key to guaranteeing a sustainable future. To accomplish this purpose, it is essential that future teachers acquire high levels of consciousness to promote important changes in the performance of students. It involves using pedagogical resources that allow students to develop a sustainable consciousness. However, educational performance, in general, has been more focused on contents than consciousness development. Nevertheless, a comprehensive education implies developing a consciousness.

The understanding of educating consciousness, and knowledge regarding the pedagogical procedures to achieve higher and more complex levels of consciousness, are some of the big scientific challenges in the educational context. Some authors [17–19] have pointed out the value of high-level teachers' consciousness in learning processes. High levels of teacher consciousness generate higher quality in students' learning. This is achieved thanks to promoting deeper and denser knowledge.

However, it is important to value the effectiveness of technological and didactic procedures according to the progress of consciousness. This is due to a bigger level of consciousness, which involves more cognitive maturity. For this purpose, it is necessary to identify external manifestations of the internal status of thought and consciousness previously. These are the key aspects that are addressed in this paper.

The essentially subjective and internal nature of consciousness makes educational research through a scientific–experimental approach difficult. This difficulty creates a big empirical void in the educational context. Our contribution goes toward identifying aspects that allow observing and analyzing consciousness. This scientific knowledge from our contribution is an initial relevant point to develop a science and a theory of consciousness. At the same time, this is essential to underlie and support pedagogical performance for teacher training.

This knowledge is also important from the perspective of performance. This makes it possible to identify and value the status of teachers' consciousness in training due to educational processes. This knowledge could be applied to other levels and educational contexts.

The previous ideas support our idea about the need to move forward in the scientific knowledge about the sustainable thought of teachers in training, as well as explore the educational power of technological resources for development purposes. From this perspective, our contribution focuses on experimentation and research in order to apply the e-portfolio to the development of sustainable consciousness in teachers' initial training.

## **2. Pedagogical Models and Competences for Sustainable Development in Teachers' Initial Training**

On an educational context, international institutions (UN, UNESCO, UNECE) have proposed pedagogical models and competences for sustainability [20–25].

In the last years, UNESCO [25,26] has proposed four approaches to deal with ESD; they call them: integrated, contextual, critical, and transformative. The first one, the integrative, takes a holistic perspective and places the different factors linked to sustainability as the focal point. This perspective gives priority to the development of the ability to link and interconnect knowledge and information. The second approach, which is contextual, gives precedence to local culture as a source of inspiration for sustainability change. It requires being able to analyze different problems, look for solutions, improve possibilities to the fullest, and choose a path, this is, make decisions. This approach gives priority to the ability to analyze and make decisions. The third perspective, the so-called critical, requires competences for awareness: intellectual competences and ethical competences. Basically, it requires developing a critical thinking. The transformative approach is closely linked to the previous one, but involves a step further: after awareness, we need actions to foster change and transformation. In this case, active and committed participation competences are required.

These methodological proposals have an eminently intellectual orientation, as they are focused on developing competences that shape thought architecture and management, which are essential for achieving sustainability. This is, they are aimed at shaping a mindset that allows citizens to take an active part in actions for a sustainable future. It involves activating different intellectual and personal competences; analysis ability, critical thinking, awareness, and so forth. However, there is room to wonder, how can we recognize and shape citizens' awareness for a sustainable future?

In the last few years, there have been outstanding efforts to identify and define operatively the necessary competences for sustainable development [20,22,25,27–35]. The existence of several key competence classifications shows, according to Brundiers and Wiek [36], that there is not a unanimous agreement. However, UNESCO has pointed out that the most important are: critical analysis, systemic thinking, collaborative decision-making, and sense of responsibility toward present and future generations, among others [37] (p. 12).

Martínez-Huertas [38] defined Education for Sustainability as a qualification for conscious actions aimed at learning to change. This definition includes important aspects to be considered in teachers' training for sustainability, such as conscious action, combining two elements: action and consciousness, which is the precedent. In addition, the inherent educational goal is to learn from action in order to transform praxis. The axes to articulate teachers' training for sustainability, consciousness, practice, reflection, and transformation have been extracted from this conceptualization [17,39].

This is, Education for Sustainable Development involves the development of competences that are related to consciousness and critical thinking [40]. These competences involve more accurate transformational pedagogical models with the approaches that are currently proposed by UNESCO. In this line of research, we need to explore ICT possibilities and potential in the application of this type of methodologies.

### 3. Consciousness as a Key Competence for Sustainable Development

Until now, there has not been a systematized knowledge that can be used as a reference to train teachers regarding Sustainable Consciousness. This article intends to advance the identification of the elements that shape consciousness development in teachers' training and the identification of consciousness types, as well as their development through training [17,18]. Herrán [17] pointed out that consciousness is an essential part of the maturity and professional development of teachers that must be taken into account for future educational training and as the axis of a new pedagogy.

The scientific literature pointed out that the teachers' familiarization with the concept of sustainability and the development of a sustainable consciousness is crucial in the educative context. This is due to teachers' need to live consciously, as they must represent the sustainable performance's view [41,42]. According to Heaton and Heaton [43], a sustainable mindset must be cultivated in the educative area, which is possible thanks to consciousness. Thus, teachers must be leaders that are capable of understanding and solving current issues. For this reason, we need awareness to start the creation of a sustainable world. These previous authors, after reviewing others, have identified

mindset or consciousness as a key factor to approach the sustainable global crisis. Teachers have the duty of developing critical awareness through training and reflecting on their own performance [44]. According to Burke and Gulbs [45], nowadays, it is necessary to create models that include teachers' personalities, integrating professional consciousness and self-consciousness as a topic for their own job performance. This breaks the limits from a more instrumental approach to teachers' professional performance to a more psychological and internal dimension, where individual consciousness lies.

The educational approach toward the raising of consciousness is difficult due to, among other reasons, the diversity of its conceptualization and operational barriers. As this is a highly complex construct and has barely been used in educational empirical research, we have a limited background of the scientific proposal that is hereby submitted. Therefore, we think we need to describe the theoretical keys that substantiate our research work.

Consciousness has been studied from different branches of knowledge. From psychology, Piaget and Vygotsky provided different approaches [46]. According to Piaget, consciousness is related to cognitive and thinking levels, suggesting a correspondence between consciousness levels and intellectual development [47–49]. According to Vygotsky [50], consciousness is the product of the internalization of external activity. It is shaped in a developmental manner through higher psychological processes, including processes for the internalization and appropriation of rules, codes, and concepts of the social group (interpsychic) and the individual's internal cognitive activity (intrapsychic) [50–55].

One of the most representative authors from an educational approach who has resorted to the concept of consciousness raising as a key axe of education is Freire [56,57]. According to him, education consists in conscientization, which is the cultivation of a critical conscience, and takes place starting from the analysis and interpretation of reality. This author differentiates three types of consciousness that are applicable both to personal development analysis and social group study: magical awareness, ingenuous awareness, and critical awareness. Each of them involves different cognitive attitudes and ways of thinking. This author conceives education as a conscientization process involving three phases: awareness, critical consciousness, and transformative action. This is a continuous process that involves reflecting on praxis. It leads to deeper interpretations of reality that, in turn, result in new levels of understanding.

Besides this theoretical classification of consciousness levels, taxonomies of conscience levels have recently been developed and applied to professional decision-making [58]. Along these lines, it is worth noting Endsley and Garland's [59] contribution on Situation Awareness (SA), which, due to its general and global nature, can be applied to the study of educational teaching praxis. According to Endsley [60], SA is the individual's level of conscience of a situation and the dynamic comprehension of "what is happening". This model identifies three levels of conscience: (1) subjective perception level, (2) meaning comprehension level, and (3) reintegration level for future projection. The integration of these three levels shape within the concept of Situation Awareness the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future [60] (p. 36).

In short, the scientific literature seems to agree on two ideas: (1) conscience is linked to cognitive processes, and (2) there are different levels of conscience linked to certain types of thinking [61]. These theories are a reference to study sustainable consciousness from an empirical–educational approach, as well as to assess the role of ICT in training.

#### **4. E-Portfolio as a Tool for Consciousness Training**

According to Gámiz-Sánchez, Gallego-Arrufat, and Crisol-Moya [62], teachers' initial training must back methodologies that involve students' active participation, supported by their personal effort and work. Two decades ago, e-portfolios appeared under these premises, which were incorporated in future teachers' training [63–67]. A research line has also been started to assess their learning potential [68–71].

E-Portfolios are a technology that has been validated by the international community to supplement professionalization processes, due to its multiple benefits: it enables connecting an entire network of different multimedia materials, it is user-friendly and exportable, and it can be shared and seen from different places [72]. Authors such as Rossi [73], Barrett [74], Hartnell-Young and Morriss [75], and Bahous [76] have supported its potential to collect and reflect on experiences, and help students manage learning. Likewise, they concluded that e-portfolios foster the integration of theory, action, self-reflection, and assessment. They are also optimum platforms to foster knowledge construction [77–80].

In this study, we shall use the Teacher Portfolio (TP), which appeared in 2010, upon the need of a change in initial teachers' training after the introduction of ICT. This e-portfolio was designed and implemented at the University of Macerata, specifically, in the department of Educational Sciences, by professors who have been experimenting and using it for teacher training from 2010 to the present [81]. TP is a tool that allows documenting the development of teachers' professionalization by collecting evidences, reflections, and descriptions, displaying the relationship established by individuals between the present (how people perceive themselves, and with which abilities) and future (toward professional enhancement). So, each student has to build his own e-portfolio using the Mahara platform.

This e-portfolio has been structured around three main axes [82]:

- Curriculum analysis: in this part, students must select training activities and reflect on their election.
- Design and application of an educational proposal: involves designing a short didactic proposal, justifying its interest, implementing it, and reflecting on its action. We established feedback among peers.
- Reflecting on a teaching competence profile: in this part, students must reflect on the necessary abilities for teaching function development. They must choose three competences that they consider important to develop it in the future [83]. Team work competence has been regarded as the most important by teachers in training [81].

The e-portfolio learning model has an individualized nature, where students' experiences depend on their knowledge, preferences, needs, and interests [82]. On the other hand, students are more involved in the construction of the learning process, which increases their awareness and their ability to identify problems, root causes, and potential solutions [62,69]. Therefore, e-portfolios provide a technological context that fosters the development of conscious, committed, and critically active professionals [40,70,84]. E-portfolios apply critical judgement and self-reflection to teaching actions and the process of knowledge construction and generation, which in turn promotes consciousness [85]. According to Dewey [86], real learning is the result of reflection on doing.

Our contribution is focused on experimenting and doing research on the application of e-portfolios to the development of sustainable consciousness in teachers' initial training.

## 5. Team Work as a Methodology to Develop the Consciousness of Teachers in Training

One of the key teaching methodologies is "team work" [87,88]. This methodology has had substantive effects in the achievement of educational goals that are closely related to sustainability, such as social cohesion, civic participation, and respect for difference, among others [89–93]. According to Brundiers and Wiek [36], it would be important to develop communication and team work skills in a sustainable future (p. 4). The literature on education for sustainability also includes interpersonal competence, this is, the ability to work in a group [36]. However, these abilities are not usually included, explicitly, in sustainability programs.

Learning to work as a team is very important due to our present society's need to solve highly complex problems that demand group collaborative work. Therefore, learning how to use each student's abilities for problem resolution and learning, enhancing innovative and successful proposals,



is an important skill for teachers [89,94]. In this regard, this is a didactic proposal that fosters inclusion, respecting and enhancing diversity [84]. Another educational value of collaborative team work concerns the variety of social interactions that are generated, which supports interpersonal links and builds a trusting foundation for social cohesion [90].

Team work also involves and implies putting into practice multiple skills such as: task planning, fixing goals and strategies as a group, time management, and learning to discuss and come to agreements with others, as well as developing commitment, autonomy, and responsibility [95–99]. All of these competences are essential for social sustainability. This methodology also promotes participation, critical thinking, solution anticipation, and decision-making in order to foster change [100–103].

The main educational goal for a sustainable future is founded on changing individuals' and social groups' attitudes (consciousness). This is about transforming the practices, attitudes, and ideas that are settled in people's cultural tradition and incompatible with a sustainable future. Sustainable Consciousness includes an entire system of knowledge, beliefs, values, and attitudes that become activated in the practice in the physical, social, and cultural environment to preserve a sustainable future [104].

In this regard, it is essential to point teachers' training toward the development of consciousness levels for a sustainable future; it is also essential, from an educational and scientific approach, to identify such consciousness levels as indicators of training effects.

## 6. Research Goals

The scientific goal of this study is to discover and describe the foundations that support the consciousness of teachers in training, as well as their level of development regarding team work methodology.

The following specific goals have been suggested:

- Identifying the aspects that shape and express the consciousness of teachers in training.
- Bringing to light possible levels of consciousness of teachers in training.
- Creating a substantive theory on consciousness training in teachers for a sustainable future.

## 7. Research Methodology

The study applied a qualitative, narrative methodology. Narrative methodology allows identifying qualitatively different forms of the levels of consciousness that are displayed by teachers in training.

We selected a phenomenographic design that is based on the study of multiple cases and applies the constant comparison method, which is a key procedure in grounded theory. Glaser and Strauss [105] were the authors that proposed grounded theory and defined it as a systematic set of procedures to develop an inductively derived grounded theory about a phenomenon. Its purpose is to bring to light theories on phenomena, rather than confirming an existing theory. Grounded theory demands identifying basic categories derived from data applying a consistent comparative method [105,106]. This methodology allows bringing to light and displaying individuals' inner thoughts and different approaches toward reality. Therefore, it is suitable for the discovery of a consciousness theory for future education professionals.

### 7.1. Participants and Sampling Strategies

In this study, we used purposive sampling in order to generate a substantive theory that is linked to the development of typologies and categories that are typical of specific situations. We selected 25 teachers in training during the internship of the last year of the Education Degree of the School of Education at the University of Macerata (Italy). The sampling size has been adjusted to the recommendations of phenomenological research; according to Creswell [107], it should be between two and 25. Our selection has been also adjusted to Smith, Flower, and Larkin's [108] proposal as,

despite being a relatively small sample, being reasonably homogeneous, which makes it possible to detect convergence and divergence to a certain extent (p. 3). Therefore, our sample is appropriate to observe both participants' homogeneity and heterogeneity in consciousness manifestations.

The final sample consists of 25 subjects who were enrolled in the Degree of Education in the specialty of Primary Education of the Department of Education, Cultural Heritage, and Tourism of the University of Macerata (Italy). They are in the last year of their degree, their fifth course, and have already completed several internship subjects, including being the object of study the e-portfolios prepared in the last practice taken during the school year 2016–2017. The average age is 22 years; in terms of gender, we maintained, approximately, the same proportion of men and women in the university career, which is why 80% of the selected e-portfolios are women and 20% are men. In the sample, a proportion of students with different grades in the e-portfolios was collected: high scores (10 subjects), medium scores (eight subjects), and low scores (seven subjects).

### 7.2. Data Collection Process

The e-portfolio, besides being useful for promoting professional consciousness, is a valuable tool for data collection. The information that is subject to analysis has been obtained through an e-portfolio [81,82]. We specifically included reflections on the value and importance of team work, which have been documented in the section "Reflection on the role of teaching competences" of e-portfolios. In this section, students reflect on the abilities and skills that are necessary to develop the teaching function. The narratives and the discourse that are implied in the reflection shall bring to light multiple expressions of «consciousness», as consciousness gets structured and organized through narratives [46].

Out of a total of 200 reflections, 25 that responded to our research goals were purposely selected (purposive sampling).

### 7.3. Data Analysis Process

Data analysis follows the procedure established by grounded theory, including: initial and focused coding, axial coding, theoretical coding, and theory construction. We briefly describe the steps applied in our study below:

- **Initial and focused coding:** In the initial stage, the researcher deals with data from an open perspective, trying to discover the concepts that are revealed by the data. In this phase, we also take research questions as a reference, trying to identify relevant data to respond to research goals. In this case, this stage of the analysis had an open, focused nature that was aimed at identifying consciousness-related expressions or categories.
- **Axial coding:** Axial codes capture and reflect the relationship between the concepts that were identified in the previous stage [109]. The axial codes that are generated have a more conceptual nature with a higher abstraction level, which allows establishing connections between more specific categories. In this case, we identified constructs that enable articulating the aforementioned categories.
- **Theory construction:** The final stage of data analysis is the development of a data-based theory [109]. In this last phase, we shall propose an initial theory on training-linked consciousness.

We used Software Atlas.Ti v.8.2.33 for technical purposes.

## 8. Results

The initial and focused coding, when applied to individuals' discourses, revealed a series of categories that were manifestations and expressions of the conscience of teachers in training on team work. Later, we established the axial codes that permitted linking and organizing the initial categories into conceptual structures. Three axial codes were identified:

1. Thinking: This first axial code combined categories that were related to the ability to conceive ideas, lay out arguments, and establish intellectual relations regarding team work. The categories that were included reflect different ways of thinking:
  - Practical–contextualized thinking: The subject starts from the context and/or the daily praxis to discuss his/her position:
 

*“I have chosen to reflect on the ‘team work’ competence, as it has accompanied me a few times during these years of university studies in different pedagogies” (Case 15).*
  - Specific experiential thinking: It takes precise, specific personal experiences as references:
 

*“Before this university experience, I did not experiment [with] team work very often . . . During these five university years, three of them in face-to-face classes (one in Perugia and two in Macerata) and two online, one of the constant foundations was just this: team work” (Case 18).*
  - Abstract thinking: Characterized by establishing relationships and connections between praxis and theory:
 

*“The ability to work in a group is one of the competences that I have developed from my experience as a university student and, upon observing its effectiveness and potential, I tried to include it in the projects and activities proposed at the school where I did my internship” (Case 8).*
  - Internalized/interactive thinking: Expresses construction from a personal conception of team work based on educational experiences that were internally reformulated:
 

*“The combination of cords tied to form a sole rope is the strength that individuals can generate as a whole, giving life to new ideas and projects, creating what cannot be created. This is the idea of team work that I built over five university years, in which the concept has adopted different meanings” (Case 11).*
  - Critical toward reality: The individual confronts his/her vision with his/her reality perception and makes a personal assessment:
 

*“Nowadays, there is a generalization at schools about team work being a waste of time . . . In my opinion, it stems from teachers’ lack of knowledge on this subject. I inform with my experience to testify it” (Case 5).*
2. Representation of Reality: It accepts categories that are linked to the time perspective adopted by subjects in order to represent reality:
  - Representation of retrospective reality: The value of team work has been elaborated on the basis of a previous experience:
 

*“Another lab practice [that was] very instructive for me was that of education and learning technologies, in which we carried out a project on the importance of water and the benefits people can obtain from it. This experience has been important during the training activities carried out in X pre-school education, where I developed an activity on primary colors following the cooperative learning method . . . ” (Case 21).*
  - Representation of the evolutionary reality: The basis of reality representation is supported by an evolutionary argumentation:
 

*“This is the idea of team work that I built during five university years, in which the concept has adopted different meanings. In my post, I had never worked in a group and I thought that it was just an addition of individual contributions, and not a generative boost, as I see it now. On the contrary, I was sceptic about the effectiveness of team work, on the belief that there was a risk that some of them*



*worked more than others. On the contrary, when I experienced it myself, I noticed that team work leads to results [that would have been] unthinkable for an individual” (Case 11).*

- Representation of projective reality: It suggests spaces for future action where team work can be included:

*“Finally, teachers must be competent to work with his/her colleagues, in a synergic and interdependent manner, as his/her collaboration does not only concern students’ learning, but also school operation” (Case 24).*

3. Type of conscience: It binds ways to appreciate, consider, and assess team work together, including the following categories:

- Perceptual consciousness: When team work has been discovered and receives attention:

*“Before this university experience, I did not experiment team work very often; of course, maybe sometimes during the school year . . . but I had never thought about it or, above all, I had never tried it or developed it from this approach” (Case 18).*

- Reflective consciousness: It involves a deep recognition of team work, as a result of a reflective personal process:

*“Team work may involve a competition spirit, and it must be avoided in practice, ensuring a pacific confrontation at all times, a moral and civil sensitiveness, experience, and intelligence that leads both individuals and groups to integration” (Case 17).*

- Sustainable consciousness: It involves a deep, transcendent vision of team work that results in a personal involvement and commitment. They project their value on the future professional and social context:

*“Personally, I believe that the ability to work in a group and collaborate is one of the key competences that everyone must have. According to Michele Corsi, we live in a society that has not defined it as one of its challenges, but still persists in an “associated” nature, this is, a group of persons who work together, cooperate, and communicate with each other for a social welfare purpose . . . The development of this social and relational competence still is a key aspect to educate new generations, but also for the adults of [the] current liquid society” (Case 2).*

In short, the qualitative methodological procedure allows us to deduce three axial codes that are present in reflections of teachers in training: thinking, representation of reality, and consciousness. Table 1 deals with the theoretical coding obtained from an inductive analysis.

**Table 1.** Theoretical coding.

		DIMENSIONS		
		Thinking	Representation of Reality	Consciousness
CATEGORIES	<i>Practical–Contextualized</i>		<i>Retrospective</i>	<i>Perceptual</i>
	<i>Specific–Experiential</i>			
	<i>Abstract</i>		<i>Evolutionary</i>	<i>Reflective</i>
	<i>Internalized–Interactive</i>		<i>Projective</i>	<i>Sustainable</i>

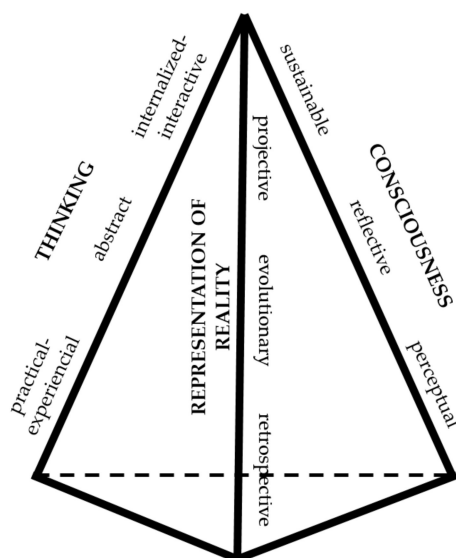
The system of categories obtained shows us that teachers in training have reflected on team work, relying on three axes: thinking, representation of reality, and consciousness. We have identified different typologies in each of these axes, as described in Table 1. Figure 1 sums up the substantive theory that was generated, based on the empirical data that was analyzed.

Individuals' positions about a certain phenomenon are articulated on the basis of a time axis: how to think about it, and how to perceive it. Table 1 registers the different options that individuals can take toward a phenomenon. Each of these axes shows different levels of development. The maximum level could be the objective of an education for a sustainable future. On the other hand, the horizontal connection of these three axes could represent development levels toward consciousness for a sustainable future.

To verify this hypothesis, we classified individuals according to their positioning in these categories.

This classification allows us to identify three groups of individuals who are linked to specific positions in the three theoretical categories, which represent different evolution levels:

- Level 1: It includes subjects characterized by expressing specific and experiential, practical, and contextualized thinking. The representation of reality is retrospective, and expresses a type of perceptual consciousness, which involves becoming aware of "team work".
- Level 2: In this level, we observe a critical, abstract thinking, establishing connections between praxis and theory. The representation of reality has an evolutionary nature. Individuals show a reflective consciousness, but they do not express an attitudinal or behavioral aptitude for action.
- Level 3: This group shows an interactive, flowing consciousness. It changes depending on new experiences and knowledge. It also expresses a projective representation of reality. Individuals propose team work projections that involve abstraction and reintegration cognitive processes, as well as creativity and imagination. This stage has also been identified with sustainable consciousness, as an affective, behavioral attitude toward change has also been observed.



**Figure 1.** Foundations that support education for a sustainable future.

Each consciousness level has been represented by a certain number of individuals: five, 15, and five, respectively. On the one hand, it shows the heterogeneity of the levels of consciousness that coincide in the same training spaces, and on the other hand, the homogeneity of the subgroups that share the same level of consciousness. The coexistence of three groups in the same training space permits theorizing that consciousness is the fruit of an evolutionary process of individuals' internal transformations. This evolution also involves a change in the discursive references; thus, in level 1, references are microstructural elements, in level 2, they are of a mesostructural type, whereas at the level of sustainable consciousness, they are at a macrostructural level. Figure 2 below shows a list of identified levels.

These findings resulted in the theory that future professionals' impressions on team work are not homogeneous, as they show different levels; such heterogeneity can also be observed with regard to types of consciousness. Academic training and professional practice may have an incidence in the development of thinking and teachers' conscience. Our contribution in this regard is to identify the multiple forms in which teachers in training think about their professional activities. The identification of consciousness levels of teachers in training is essential both to understand training evolution and development, and substantiate effective pedagogical proposals. Figure 2 synthetizes the substantive theory that was found regarding the levels of consciousness registered.

The aforementioned discoveries lay the foundation for inspiring and guiding educational proposals to train teachers for a sustainable future. One of the foundations is the discovery that sustainable consciousness is the last step of an educational and maturation process that involves a good command of the previous types of consciousness; and that consciousness is supported on thinking which, in turn, presents different intellectual levels. From a pedagogical perspective, consciousness development for a sustainable future requires activating and developing these three foundations.

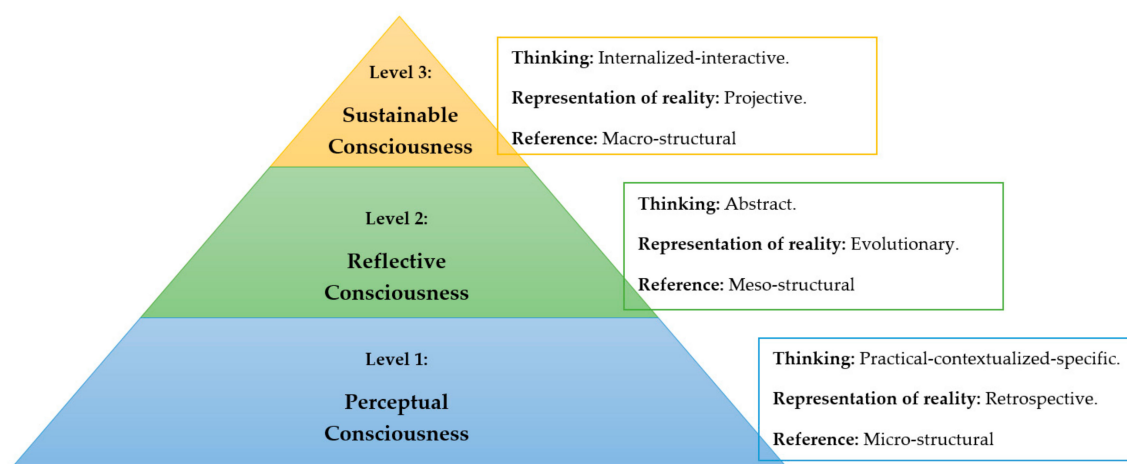


Figure 2. Levels of consciousness of initial training teachers.

## 9. Conclusions and Discussion

The empirical findings of this study can be summarized as: (a) identifying a category system that supports individual's consciousness in training contexts (see Table 1), (b) determining the cognitive axes that explain the registered categories: thinking, representation of reality, and type of consciousness (see Figure 1), and (c) disclosing three levels of consciousness and their characterization (see Figure 2).

The outcomes obtained in the categories that referred to thinking show agreement with other studies and theoretical contributions [46]. Thus, the identification of modes of thinking combined in the types of consciousness converge and feed Piaget's theory on consciousness, as there is a parallelism between levels of thinking and consciousness [47–49]. Our outcomes enable explaining these levels in great detail, as described in Figure 1. On the other hand, in the characterization of the consciousness levels that were registered, we have observed through the texts elements of Vygotsky's theory on consciousness, as they express and register internalization processes of external activities [50–55].

On the other hand, the empirical attainment of three levels of consciousness (perceptual, reflective, and sustainable) converges with the types of consciousness proposed by Freire [56,57]; however, they can also be added to the taxonomy of Endsley's levels of consciousness [60]. Therefore, in a scientific context, we can conclude that theoretical approaches find a correspondence in the empirical data that was obtained in our study in training contexts.

These levels represent gradients in the intellectual evolution of individuals and define spaces that must be addressed from an educational approach. The maximum level of all of them could be the objective of an Education for Sustainable Development. Training may play an important role in

the evolution of the levels of consciousness and thinking until reaching levels that allow an active involvement in the creation of a sustainable development.

The quantitative analysis performed confirmed that not all individuals reach the highest values, as certain individuals respond to initial and medium degrees of consciousness. Such knowledge is essential both to understand the evolution and training journey followed by individuals and to support effective pedagogical proposals, which are adjusted to reference conditions. Therefore, these findings are relevant to direct teachers' training with regard to a sustainable future [104].

We understand that the results showed here, given the complexity of the subject discussed, are limited, due both to sampling particularities (the sample was just made up of teachers in training) and the strength of the data obtained. In this regard, it would be necessary to extend the empirical data to validate the categorization system in other training contexts, applying different training methodologies and technological resources.

Our study is focused on how teachers in training perceive and take a stance on team work. In this case, team work is the element of external reference on which individuals' thinking and consciousness is projected. Other key subjects in sustainability right now could be managed from a consciousness approach, such as gender violence, sexual identity, xenophobia, addictions, etc. However, it could also be transferred to other spaces typical of sustainability, such as financial and environmental areas.

The scientific value of this contribution, from our point of view, is to bring to light and clarify dimensions and categories that are part of the internal processes that are associated with the development of sustainable consciousness. This categorization can be a useful tool to carry out empirical studies of the conscience applied to diverse contents (moral conscience, social conscience, ecological conscience and so forth) in future investigations. Given that consciousness has an internal nature and obeys essentially subjective processes, it is important to have verifiable manifestations that make it possible to investigate and develop a "science of conscience".

On the other hand, the identification of levels of consciousness and cognitive manifestations is an important starting point, at a scientific level, to develop a theory of consciousness applied to educational and training processes.

From an educational perspective, to have indicators or references to recognize and register external expressions of sustainable consciousness is the key for teachers' training, even in other educational levels. This fact makes possible to use empirical references to identify, value, and develop consciousness.

The findings of levels of consciousness in teachers in training to face team work is a relevant contribution, as it gives visibility to the stages of development of consciousness that are operative during the training of teachers. The purpose of this work is to promote and increase the consciousness of teachers to a maximum. The identification of thought levels and the views of reality that are associated with the levels of consciousness are important findings in terms of science and education. This can be explained as these levels of awareness not only work as stages to underlie the educational projects for teachers' training, they also determine and get to know the development of the effects during training.

Another scientific value is the mainstreaming of the application of these findings, as they can be applied to training in all of the educational levels from diverse topics, such as gender equity, consciousness about social justice, and ecological consciousness, among others. Another important finding is the high value of the e-portfolio as a tool in the scientific and educational fields, not just for the development of teamwork consciousness, but also for the expression and assessment of the consciousness levels achieved in this training. The application in the real context of university training may become a reference for its subsequent application to other fields of knowledge and other university degrees in different educational contexts.

This study also demonstrates that the e-portfolio is a tool or pedagogical resource with a high potential to develop sustainable consciousness in university students.

If the goal of Education for Sustainable Development (ESD 4) [1] is to redirect education and learning so that all citizens can contribute to sustainable development, it is essential to get to know how to achieve a level of consciousness that allows participating in the construction of sustainable development. Hence, the relevance of a research line that is focused on the analysis of consciousness in educational contexts.

This research field is not just attractive and respectable; its disclosure constitutes one of the most relevant and updated research focuses, given its theoretical and practical implications [46].

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