

# EL PLANTEAMIENTO DE LA INTERDISCIPLINARIDAD EN LA ENSEÑANZA DE LAS CIENCIA NATURALES POR EL PROFESOR TOMÁS ALVIRA

## THE INTERDISCIPLINAR APPROACH IN THE TEACHING OF NATURAL SCIENCE BY PROFESSOR TOMAS ALVIRA

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### **Resumen**

En este artículo se analiza la importancia dada a la interdisciplinarietà en la enseñanza de las Ciencias Naturales por parte del doctor en ciencias químicas y catedrático de Enseñanza Media en el Instituto Ramiro de Maeztu de Madrid Tomás Alvira Alvira (1906-1992), figura destacable en la historia reciente de la educación en España. Quizá su mayor aporte innovador fue el enfoque multidisciplinar a la hora de enseñar las ciencias naturales y la combinación de trabajo teórico y práctico con los estudiantes. Sus ideas y propuestas en torno a la interdisciplinarietà siguen siendo valiosas para la didáctica y la pedagogía en la actualidad.

**Palabras clave:** 5801.04 *Teorías educativas*, 5801.05 *pedagogía experimental*, 5801.07 *métodos pedagógicos*, 7206.99 *ciencias naturales*, 5801.99 *interdisciplinariedad*, 5803.02 *Preparación de Profesores*.

## Abstract

In this paper, we will analyze the relevance of interdisciplinarity in the process of teaching Natural Sciences by Tomás Alvira Alvira (1906-1992), Professor of the Institute Ramiro de Maeztu (Madrid), who is an important figure in the recent History of Education in Spain. His most valuable input in the innovation was the multidisciplinary focus on teaching Natural Sciences and the theoretical and practical proceeding with students. These ideas still are valuable in current didactics and pedagogy.

**Keywords:** 5801.04 *Educational theories*; 5801.05 *Experimental pedagogy*, 5801.07 *Pedagogical methods*; 7206.99 *Natural Sciences*, 5801.99 *Interdisciplinarity*, 5803.02

## 1. Introduction

Carmen Morón and Aurelio Usón (1997) concluded a work dedicated to the pedagogical innovations in the didactics of natural sciences in the first third of the 20th century with the following words:

All this makes us wonder, to what extent has the teaching of physical, chemical and natural sciences in elementary school evolved since the beginning of this century? In terms of technological and economic resources, as well as other socio-cultural characteristics, it would be absurd to deny the impressive changes that science teaching in elementary school has undergone. However, regarding basic issues, such as the previously mentioned didactic principles, we are surprised, and very pleasantly so, to find that many of the proposals and criticisms of the authors of the first third of the twentieth century that we have studied in this work are still relevant today. Thus, these authors may well be considered today as innovative and very significant in the field of science education in our country.

These words are perfectly applicable to Tomás Alvira Alvira (1906-1992), a famous teacher at the Ramiro de Maeztu Institute, who stands out in the history of contemporary education in Spain for his great dynamism and commitment when teaching and organizing education in the Spanish educational system between the 1940s and 1980s. He came from a great pedagogical tradition (his father was a famous Aragonese teacher, Tomás Alvira Belzunce, and he was trained by teachers and readings that dealt with the aforementioned authors Morón and Usón) and, although he was not a great innovator (except, perhaps, in the development of what he called the *Aula viva* ("Living classroom")), he did know how to make great contributions that are still useful today. In this sense, his pedagogy cannot be understood without interdisciplinarity, both in teacher training and in the teaching-learning process with the student. In order to analyze this question, the work presented here is divided into five main sections: the personality of Tomás Alvira and his integrating character (especially in the ideological aspect), his integrating conception of education, teacher training (as interdisciplinarity between the specific knowledge of the subject taught by the

teacher and his training in pedagogy), interdisciplinarity in student training and, finally, the materialization of these ideas not only in the texts he wrote but also in the creation of Living classroom at the Ramiro de Maeztu Institute.

## **2. The person of Tomás Alvira and his integrating character**

On April 6, 2011, took place at the Ramiro de Maeztu Institute in Madrid the conference "Lo llevas dentro" to encourage vocations to the study of chemistry, within the framework of the Year of Chemistry that was then being celebrated. The event was attended by the then Minister of Education Ángel Gabilondo, who said that "the world can be transformed, and chemistry is a good way to achieve this, so it is necessary to awaken interest in science at an early age, because our young people will make the future better" (quoted by Fernández, 2011). Gabilondo, both as a professor, rector and minister, has always expressed the importance of the social dimension of education and the unity of the different disciplines of knowledge, as in a paper with the eloquent title "Aristotle: It is neither of science nor of letters", where he stressed the importance of the social dimension of education and the unity of the different disciplines of knowledge, where he emphasized the moral and social relevance of all knowledge, and how it is not correct to divide the globality of knowledge into isolated specialties without any connection between them. On the contrary, Professor Gabilondo observed, there must be communication between knowledge and students, so that, regardless of their inclination (towards the "arts" or the "sciences"), they must receive a good global education.

These affirmations will encounter among teachers a broad consensus. Indeed, education requires a solid anthropological basis (conception of the human being, society...), an ethical and social dimension and, finally, interdisciplinarity, that is, the combination of diverse knowledge (pedagogy, philosophy, law and the particular disciplines that each teacher must teach) so that students can reach a global knowledge and do not conceive the subjects as isolated knowledge to be overcome through an evaluation, but as parts of a

culture that has a decisive role in their configuration as a person. Perhaps, with regard to the contents of this conception of the human being and society, there may be greater discrepancies in a pluralistic society such as the Spanish society of the 21st century.

An example of the value of multidisciplinary and of the ethical and social dimension of teaching (although with a philosophical and ideological approach different from that of the aforementioned professor and politician) can be seen in the pedagogical legacy of Tomás Alvira Alvira (1906-1928), who was a doctor in Chemical Sciences and professor at the Ramiro de Maeztu Institute. In fact, for Tomás Alvira, the teacher should not limit himself to knowing his area of study well and transmitting knowledge related to his discipline but should live his work as a vocation for the formation of the person. On the other hand, between the 1940s and 1980s, he actively worked for the pedagogical training of teachers and for the interdisciplinary nature of teaching for the integral formation of students. Therefore, it is worthwhile to investigate his contribution, which, together with that of other professors and teachers, has contributed to the improvement of education in Spain. Perhaps his methods and approaches are, today, normal for any teacher, but it seems worthwhile to present his ideas and his work as part of the history of Spanish education.

This commitment to educational improvement on the part of the aforementioned teacher materialized in a quite considerable written production, as well as in the performance in positions of responsibility, such as the sub-direction of the Ramiro de Maeztu or the reform of the Infanta María Teresa Residence. In all this, Tomás Alvira maintained collaboration and coordination with the education inspectors<sup>1</sup>, especially in the management of the Infanta María

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<sup>1</sup> Tomás Alvira, in fact, took part in the work that also falls within the remit of the Education Inspectorate. Alfredo Méndiz (2022) summarises the responsibilities he had in this respect: "In 1953 [...] Alvira had been appointed, in the Ministry of Education, member of the recently created Central Board of Scientific and Pedagogical Material; in 1956 he was appointed member of the Technical Cabinet of the General Directorate of Secondary Education; in 1959, member of the National Council of Education; in 1962, member of the commission in charge of preparing an agreement between Spain and the OECD on biology didactic (p. 181).

Teresa School<sup>2</sup>, and received praise from inspectors such as Carlos Vidal Box (Méndiz, 2022, p. 188). He also worked hard on the implementation of student tutoring, the creation of parents' associations and psycho-pedagogical care<sup>3</sup>.

Finally, it should be noted that Alvira also developed a notable scientific activity, working in the field of soil science at the Consejo Superior de Investigaciones Científicas under the direction of José María Albareda, where he carried out important studies, although his teaching vocation led him to progressively abandon that line of work to focus on teaching. Nevertheless, he remained linked to the Council through the San José de Calasanz High School and was part of a generation of teachers who combined high level research with secondary education, as noted by the pedagogue Víctor García Hoz (prologue in Alvira, 1952, p. V). This is also important, as his biographers have emphasised, because of the idea of raising professional work to the highest dignity (a good person must be a good professional, and vice versa) and the notion of unity of life, which gave his teaching an integrating humanist spirit and contributed to the interdisciplinary nature of teaching (natural sciences, pedagogy and philosophy). This is the view of those who have studied his figure in depth (Méndiz 2022, p. 189; Lozano 2022 a, pp. 89-90).

As we can see, Tomás Alvira was a teacher who excelled in various fields (social pedagogy, natural science didactics, school organisation...) and played an important role in the development of teaching and pedagogy in Spain, and there are already important studies on this subject. This already constitutes, in a way, an aspect of interdisciplinarity, since a good teacher must be prepared, in principle, not only to master his or her subject but also to know how to teach it and to deal

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<sup>2</sup> The reform of this school was Alvira's most genuine work, as he had great freedom to undertake it in his position as headmaster. Alvira included among the formative aspects of the school's educational plan "to encourage sincerity between teachers, inspectors and pupils, cultivated through a truly affectionate treatment" (Lozano 2022 a, p. 112). His work in this centre would merit the praise of inspector J. Hermida (vid. Lozano 2022 a, p. 127).

<sup>3</sup> As director of the Infanta María Teresa, a centre that was elevated to the category of experimental centre, he introduced the psychological cabinet that would be run by Juan García Yagüe (Méndiz, 2022, p. 166).

with issues that go beyond it, such as school organisation or dealing with the social environment of the students.

Perhaps one aspect with which many teachers do not identify is Alvira's religious or moral convictions. Indeed, this dimension of Tomás Alvira's conscience could be seen by many as an impediment to connecting with his pedagogical ideas, insofar as these personal convictions are not shared. However, insofar as the transcendent dimension moves in the field of natural ethics, it can be integrated into the pedagogy of people of very different convictions, if we consider that it is ultimately a question of living the professional work from a moral dimension, of whatever kind, with or without a transcendent conception.

In any case, Alvira had the virtue of being an open-minded person on ideological issues<sup>4</sup> and incorporated in his training and teaching the contributions of the educational tradition of pedagogues such as Pestalozzi or Dewey (Lozano, 2022 b, p. 198), the *Escuela Nueva* (New School) or the *Institución Libre de Enseñanza* (Free Institution of Education). In this regard, María del Carmen Ripollés (discussing the history of the didactics of natural sciences in contemporary Spain), states that in the Franco era "an attempt was made to eliminate any trace of republican reform, rejecting the educational ideals of the Republic and putting Catholicism and patriotism first" (2014, p. 74). However, the reality is that, in the case of Alvira (and others), many of those advances were taken up and continued, as José Juan Lozano says when talking about the Free Institution of Education (2022 a):

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<sup>4</sup> The biography written by Alfredo Méndiz (2022) speaks of the friendships that Tomás Alvira maintained before, during and after the Civil War, which included people with left-wing and republican political convictions, such as the Latin teacher Alfonso Turmo, who helped him during the war and who, after the war, helped him by testifying in his favour at his trial for having been an army officer on the republican side, who helped him during the war and who, after the war, he helped by testifying on his behalf in the trial he suffered for having been an army officer on the Republican side, so that he was soon able to reintegrate into civilian life (p. 101). He also maintained contact and collaboration with the famous scientist and natural scientist Enrique Rioja (who went into exile after the Civil War), to whom he sent minerals for the museum-laboratory that he organised in Madrid (p. 57).

This institution, in addition to being an entity that sought to replace traditional philosophy with Hegelian thought, to overturn the political regime and to give a pantheistic sense to the religious dimension of man —aspects that had no impact on Alvira's thinking— nevertheless brought about a renewal in the culture, pedagogy and education of Spanish society, which was necessary at the time.

Aspects of intellectual height and good educational taste remained in force in Spain, not only until the beginning of the Spanish Civil War, which marked the decline of this cultural movement, but also for a long period of time and had a sufficient influence on the Spanish educational environment.

Therefore, Alvira and other teachers who had a great concern for education; who sought to learn; and who, without belonging to any educational movement, knew how to incorporate into their way of doing things those intuitions and ideas that others had discovered, perceived in this institution formative elements that should be observed (pp. 56-57)

In a pluralistic society such as the current Spanish society, and where pluralism, tolerance and the search for integration and consensus are encouraged, Tomás Alvira presents himself as a precedent and allows us to understand why he gave so much importance to integrating diverse points of view and disciplines of knowledge in a society where each individual (according to him) should find their own genuine path).

### **3. A global idea of education**

We began the previous section by mentioning Aristotle, whose tripartite division of the spheres of human action (ethics, economics, politics) is very appropriate for Tomás Alvira's integrating vision of education. Indeed, Alvira paid much attention to the education of young people not only from the purely intellectual, but also moral, social and spiritual instruction. We could summarise all this in a humanistic conception of education, evoking the ancient *Studia Humanitatis* where the development of all the powers of the human being was sought. This is reflected in his own words:

I cannot conceive of a subject in the Baccalaureate that does not have, in one way or another, a formative value. The Natural Sciences do: observing, experimenting,



ordering, deducing properties from structures, enjoying the beauty of the variety of shapes and colours that Nature contains, etc., are facts that undoubtedly have an influence on the spirit of the person who does them (Alvira, 1955, p. 136).

These approaches are close to what is also being proposed today. In fact, there are proposals that defend the humanistic approach in the teaching of the natural sciences, since "separating the scientific content of the hard sciences from the human value of the man or woman who produced it, from his or her family and social relations and from the era in which he or she lived, can lead to the commission of an error whose cost is the rejection of the study of these sciences" (Contreras; Valle; Pedraza, 2021, p. 102).

In a lecture given at a summer school organised by Fomento de Centros de Enseñanza, Alvira summed up his ideas on the figure of the teacher, which should be the basis on which to develop teaching, whatever the specific discipline that each teacher was to be in charge of. For him, "all reality is formal. Without form there is nothing. But the form has to be adequate to the end" (Alvira, 1985, p. 3). From here, Alvira sets out the various qualities of the good teacher according to the aims pursued (committed vocation, solid training, intellectual, moral and artistic virtues...). We cannot dwell here on this whole ideology which, moreover, has already been dealt with in depth (Lozano, 2022 a, pp. 237-370). What is important here is to point out the importance given to having a "strong thought", a true philosophical basis that brings together all the dimensions of the teaching task (instruction, education, guidance...). This is what he said in the following words: "a quality teacher must consider himself to be an intellectual and must respond to this concept. To be an intellectual requires intense study, to be up to date, to have the desire to seek knowledge, to think" (Alvira, 1985, p. 11). (Alvira, 1985, p. 11). In this, Alvira assumed the pedagogical ideal of José María Albareda: "The human person is not a duality of matter and spirit, but a harmonious conjunction of these parts", wrote a pupil at the institute a few years after finishing his studies there. This is the education that we intended to give at the "Ramiro de Maeztu" (quoted in Alvira), 1992, p. 21).

Such was this reality in Alvira that it inspired the philosopher Leonardo Polo to develop his ideas on education in his system of thought in which educating is helping to grow (see Polo, 2006). A good summary of what we are trying to state here about the necessary philosophical basis for interdisciplinary teaching is made by Joaquín León-Parodi (2022) in a work dedicated to the philosophy of education of the aforementioned Leonardo Polo, where he alludes to Alvira:

Among the many disciplines that study education, philosophy of education is the most relevant. This is because philosophy is in the order of truth, not of the plausible or merely utilitarian, and it seeks to ground the different realities in which human beings are immersed. When we begin a foundation of education, it becomes clear that it is not possible to base it on the empirical sciences, since when we come to the question of "what for", we find that these do not provide a solution. This is why it is necessary to turn to philosophy (García Hoz, 1960). In this way, if we disregard the philosophy of education, we can easily fall into the belief that today, with the progress of science, we know much more about education than ever before, but we forget that we know "less than before about the fundamentals, about the meaning of life and its purpose" (Sellés, 2020, p. 167). Therefore, philosophy cannot be disregarded when studying education, as it is the one that allows us to avoid the danger of education being transformed into a mere technique or instruction, as it should not be confused "with giving and ensuring that rules of civility are practised; nor with the mere acquisition of knowledge" (Alvira, 1983, p. 12). (p. 24)

Hence, this philosophical basis led Tomás Alvira, in collaboration with so many other colleagues, to seek a truly interdisciplinary education at Ramiro de Maeztu:

From the moment they began their studies at secondary school, the tendency was for pupils to see the baccalaureate as a time in their school life in which broad horizons were opened up to them, a panorama which would allow them to come into contact with very varied aspects of human life, necessary for them to have the most complete education possible, to achieve the best development of their personality, to be able to incorporate themselves suitably into the society of which they must form part and to be able to act in an appropriate manner.

Sometimes it is sad to listen to eminent people of knowledge who, because they have always been totally immersed in a small area of human knowledge, are the ones

who know the most about this limited field, but they miss other wonderful things that give juice and transcendental value to human life (Alvira, 1992, p. 27)

In the ethical field, Tomás Alvira saw the need for a transcendent and moral education that was nevertheless compatible with scientific development. Thus, in his textbooks he invited students to consider the theory of evolution compatible with the idea of creation and not to make a literal reading of the biblical account (Alvira; Gómez-Menor 1970, p. 183), something that may surprise us today but which at that time was a more debated issue. In his textbooks he also tried to teach healthy habits based on the teaching of natural sciences. An example of this is a textbook he prepared for the second year (Alvira; Gómez-Menor, 1970): many subjects ended with tips for everyday life related to the subject (on the subject of the sense of sight, eye hygiene; on the auditory system, ear hygiene, etc.).

In the field of economics (understood as "the law of the home", since the word is composed of *oikos* —house, home— and *nómos* —law, rule— and thus alludes to the regimentation or way of administering the domestic space in which the family lives), we can situate here the importance given by Alvira to the influence of the pupil's family environment. José Juan Lozano (2022 a) attributes to him the creation of Parents' Associations in baccalaureate studies (p. 384), and Alvira devoted some works to helping parents in their educational responsibility, for example *¿Cómo ayudar a nuestros hijos?* (1976) or *Enseñar a querer* (1989). Communication between schools and families, which is still a fundamental pillar of education today, deserved, as we can see, a lot of attention from Tomás Alvira.

In the field of politics or human society, Alvira gave education an important social dimension (see Lozano 2022 b). He defended, for example, the value of team practices for their social (exercise of social virtues, development of group spirit...), intellectual (development of the critical spirit, development of the habit of expression) and moral purposes, since respect for others or the formation of character was encouraged (Alvira, 1955, p. 137). In this sense, he defended the value of science and technology for the development and prosperity of society,

as well as the importance of collaboration between both types of knowledge, as he wrote to the students:

I don't know if, before reading these lines, you have ever stopped to think about the difference between science and technology. Now that there is so much talk about scientists and technicians, it would be useful to have a clear idea about the meaning of these terms.

Both science and technology are knowledge, but of a different order. Science is theoretical, contemplative knowledge; its sole purpose is to observe, contemplate, describe, analyse objects. Technique is a knowledge whose aim is the production of objects. Although both are knowledge, they are different in character. Man can have two different habits: the scientific and the technical.

The more we know about nature through science, the better we will be able to use it to produce artificial objects, which is the nature of technology. This is why scientific progress is usually accompanied by further technical progress.

It is rare - precisely because science and technology are two different habits - that the same person advances theoretical knowledge and is able to produce objects.

The advance of technology has facilitated means of experimentation that in many cases have broadened the scientist's field of study. In this sense, it can be said that technology has advanced science (Alvira; García, 1975, p. 99)

In the field of technology, Tomás Alvira contributed a great deal to teaching in the field of agriculture. As early as 1946, he advocated the creation of "institutions where, together with a general primary education, pupils are given the fundamental agricultural knowledge that will enable them to move away from the routine habits of their predecessors" (p. 438) and he lamented, to a certain extent, that the subject of agriculture had been removed from the school curriculum and that, given the importance of the sector, the young people who were destined for agricultural work could not be given the technical and scientific knowledge to train as engineers or agronomists.

Thus, he wrote in a text dedicated to the study of the soil for primary school education (1965):

The reader may be surprised to see in these lines that the knowledge of soil is recent and that its study began a little more than a hundred years ago. If this is the case, it is because the reader has heard and read in many books and magazines that knowledge of soil is very old and that agriculture has been developing for hundreds of years, with a voluminous bibliography. In all this knowledge, in all this literature, we find that soil is treated from a utilitarian point of view, insofar as it is capable of producing crops. But soil is, above all, a natural entity and, as such, it can be studied from a purely scientific point of view, a study that encompasses physical, chemical and biological processes that do not enter into yields, although they are the starting point to look for them later on (p. 9)

Indeed, he paid attention to agricultural schools and produced teaching materials for farmers and stockbreeders. In fact, Miguel Lacruz (1997) points out that Alvira's texts constitute one of the few studies of Spanish agricultural schools in the second half of the 20th century, even if only superficially (p. 18, n. 1). For example, he published a didactic booklet for them in which he tried to transmit, as simply as possible, technical knowledge that agricultural workers could use, trying to reach these readers without falling into paternalism (1968, p. 3): "I know that you have been doing agricultural work for years, but the tasks that all men do can be perfected, and I believe that it is our duty to seek the means to make them more and more perfect". Alvira insisted on the value of the traditional knowledge of farmers and stockbreeders, but urged them to professionalise their work, so he encouraged readers to get training, as specialised training in the trades was increasingly required in order to obtain better pay. In this way, and in a very direct way, he set out for them the "road to success" (1968, p. 39): "1) Obtain a certificate of primary studies; 2) Follow a course of "Correspondence Studies"; 3) Attend a course of Intensive Professional Training; 4) Achieve some specialisation by attending a course of Accelerated Professional Training; 5) Try at all times to raise your cultural level".

In short, Tomás Alvira conceived education as a whole, ranging from the individual formation of the person to the whole of society, so that all knowledge has a formative and social development value. It is in this framework that his ideal

of teacher and student training, with great attention to interdisciplinarity, must be understood.

#### **4. The importance of teacher training**

In Tomás Alvira's time, the figure of the high school professor was quite different from today. There is no doubt that the professors had a solid intellectual training in the science to which they were dedicated, but this was not always accompanied by an appropriate pedagogy for the recipients of their teaching, such as secondary school students. Alvira himself recognised that, at the beginning, he himself suffered from this shortcoming:

At the beginning of my professional life, my lectures consisted of carefully prepared lectures. But I soon realised my mistake; I realised that I was only acting as a transmitter of knowledge, as a conduit, as a transmission cable. And I thought that this was not the way forward. I had to be not just a channel, but a stream of water that fertilises; not just a transmission cable, but energy that sets things in motion. In short, my work in the classroom had to be that of an educator: helping my students to develop their personalities [...] I began to draw up projects that would separate me from the classroom as a lecture hall, that would distance me from the concept of the classroom as a place where the "explain-examine" binomial develops, where the teacher could be replaced by tapes or videos (Alvira, 1992, p. 220)

Therefore, we see here another important facet of interdisciplinarity in Tomás Alvira's teaching: the teacher must first of all be very competent in the subjects he teaches, but he must also know how to transmit them with the support of pedagogical discipline, something that had already been applied for some time, as in the case of the Escuela de Estudios Superiores del Magisterio and the Instituto-Escuela (see Negrín-Fajardo, 2021, pp. 244-245). For him, the teacher should not "tire a pupil with small details of his subject, without thinking that the knowledge given by that subject is only a means, which, together with the other means of that centre, has as its objective the best development of the pupil in all his aspects" (Alvira, 1969, 28). This requires not conceiving the teaching of one's own discipline without connection with others taught by other teachers, and this feeling was not exclusive to Tomás Alvira. Indeed, Manuel Mindán

recalled in his memoirs that the teachers at the Ramiro de Maeztu Institute (where he was Professor of Philosophy) defended their independence with regard to the ideology of the centre:

The ideal and the educational criteria came from the teachers themselves. We proposed to work as a team. In order to agree on criteria and methods, the professors who wanted to create an Institute as could be expected from the conditions we had been given, met frequently. Some trusted the others and did not attend, perhaps because of the inopportune time of day: we usually had meetings in one of the boarding schools, where we stayed for dinner and then continued talking until two or three in the morning. Chaired by D. Luis Ortiz, these meetings were usually attended by Vilas, Magariños, Oliver, Alvira and myself; occasionally Ybarra, and some adjuncts such as Brañas, Dellmans and Vilaplana used to join in (Mindán, 2001, p. 83).

As we can see, Alvira was a man interested in pedagogical debate with his peers, and he did not fail to get involved in meetings which, as we can see, could last until the early hours of the morning. This would lead him to participate in the activity of the Instituto San José de Calasanz directed by the professor of pedagogy Víctor García Hoz, whose pedagogical missions sought as an important point the training of teachers (Méndiz, 2022, p. 152). The collaboration between Alvira, García Hoz and other teachers and researchers was close for many years, and "the option for scientific pedagogy, that is, for the empirical study of the educational process, as opposed to the Spanish tradition of intuitive pedagogy or even anti-pedagogy, was from the beginning a distinctive feature of that group of pedagogues and teachers, even though some were dedicated to non-experimental fields such as philosophy or the history of education" (Méndiz, 2022, p. 180).

This did not prevent Tomás Alvira from criticising the position of those who focused too much on the development of pedagogical methods, neglecting the work on the disciplines they had to teach their students: "How many teachers do we see today full of pedagogical techniques, boasting a pedantic modernism and, nevertheless, with mediocre results in their educational task" (Alvira, 1985, p. 8). In fact, although it can be seen (in some of the quotations or concepts he used)

that he read pedagogical literature, he did not include extensive bibliographies in his proposals for teaching innovation. In fact, Alvira was not a pedagogue, but an experimental educator (Méndiz, 2022, p. 189).

In the field of agricultural education mentioned above, Alvira produced materials not only for students, but also for teachers. For example, from his notes, and the contributions of other colleagues, he produced a book entitled *La iniciación agrícola en la escuela primaria* (1965), with the intention of "providing our schools with very appropriate information on the scope and content that should be given to agricultural education, which, although it seems to have been somewhat forgotten for a long time, it is right that it should be reconsidered again and brought into line with the boom that our agriculture has taken in recent times and to which the school cannot remain oblivious" (p. 7).

## **5. Interdisciplinarity, in textbooks and in the classroom**

This value of interdisciplinarity was consciously rooted in Alvira's pedagogy, as we can see in the following writing, addressed to the teaching community (1955, pp. 136-137):

In the Baccalaureate there is an organisation of subjects, specific programmes, which set limits, not so much to the extent of knowledge that students will acquire, but rather to the subjects that will be studied. As far as Natural Sciences are concerned, physical phenomena, chemical phenomena, the functioning of natural beings, etc. are studied separately.

It would be dangerous for pupils to finish their studies believing that the knowledge they learnt separately was unrelated to each other [...].

It is becoming more and more difficult to limit these sciences, their boundaries are becoming more and more blurred, there is more and more talk of problems of scientific jurisdiction and, as a consequence of all this, compound names for new sciences are emerging: physicochemistry, geochemistry, biological chemistry, etc. [...]

The pre-university course, without prior syllabus, without pressure to complete a certain number of lessons, with the precise knowledge of each of the sciences that together make up the Natural Sciences, could have a precious value of combining



subjects, of unified vision, of crossing knowledge acquired separately and which, united, give us the natural phenomenon that amazes us: the deep erosion that shapes rocks, the formation of the soil that makes plants live, the physiological acts that allow the development of plant and animal beings...

For this reason, Alvira proposed that, in the Pre-University course, subjects should be sought that would break "the limits of a single scientific discipline to cover several of them" (1955, p. 137). Indeed, specialisation in different sciences was for him "a consequence of the material lack of time to provide the student with the instrumental knowledge that would enable him to successfully undertake higher studies" (Alvira, 1959). In fact, he and other teachers at Ramiro de Maeztu tried to give interdisciplinary lessons to help students to have a global vision of science or, if you like, a multidisciplinary perspective. They proposed, for example, the study of an object that could be analysed from different perspectives, such as a car (materials through chemistry, aerodynamics through physics...). However, they had to give it up after the General Directorate of Secondary Education sent reports ordering that teaching should be carried out according to the traditional moulds of the subjects (Alvira, 1959, p. 594).

In the twilight of his life, Alvira recalled the pedagogical ideal of the Ramiro de Maeztu (where he was deputy director for many years) with regard to the rejection of absolute specialisation in teaching: "The aim was not to create specialised minds that see only that small parcel of knowledge that they are going to cultivate all their lives, without looking at other aspects of human life that give a broader, more complete vision of the world around us" (Alvira, 1992, p. 26). For this reason, in that centre they insisted on this aspect:

Each teacher had to emphasise the educational value of the subject he or she taught, but without losing sight, at the same time, of the need for complementary training: for science students in various subjects of letters, including Latin and Greek; and for students of letters in certain science subjects, including mathematics. This is how they acquired a broad culture, which is what a university student should have. What was not wanted was for students to see their baccalaureate studies as a mere transitional stage on the way to a university selling professional qualifications (Alvira, 1992, p. 27).

But these ideas did not only apply to Baccalaureate (Bachillerato) students, but also to the youngest students, adapted, of course, to their ability. Together with other colleagues, Tomás Alvira prepared textbooks for E.G.B. which had three volumes: the pupil's reference book, the teacher's book and worksheets. The book for 6th grade teachers began as follows:

In this course, a systematic approach to the study of science begins; the pupils begin to know that there is some knowledge that belongs to the domain of physics, some to chemistry and some to biology. It is good, therefore, that we make them see this, but we must also strengthen the fundamental idea that in nature there are a series of phenomena in which physics, chemistry and biology have a bearing. In these cases, we will seek knowledge of the fact, of the complete phenomenon, without the need to separate some knowledge from others because they belong to different sciences (Alvira; Martín; Oñorbe; Ruiz, 1972, p. 3).

Years later, as a teacher, he wrote in one of his textbooks (1975), addressing the student, the following words: "The observations you have made have shown you other celestial bodies than the Earth. This should make you think that studying natural beings does not only consist of observing them, but also of relating them in order to know the influence that some exert on others" (p. 3).

Rafael Alvira, son of the protagonist of this article, stated that his father was probably interested in research into soil science because of "its integrative nature, the fact that numerous disciplines converge in it: both zoology, due to the rich animal universe that the soil contains within it, and geology; both chemistry, due to the reactions of water, when it penetrates, with the various elements, and climatology..." (quoted in Méndiz, 2022, p. 130). Perhaps because of this multidisciplinary value (and because he was an authority in this field of research), he included in his textbook's sections dedicated to this discipline, precisely because of its interdisciplinary nature. In one of his books, addressing students (1975), he said: "Soil science [...] is the science of soil, and soil has its origin in rocks. It is natural that the knowledge of rocks should be of interest to the soil scientist, and this study corresponds fundamentally to the geologist. The study of rocks by

the geologist will always be of value to the soil scientist, who has to study the material placed on top of them, i.e. the soil (p. 107).

Interdisciplinarity necessarily entails a process of understanding and comprehension of ideas and their scope. Alvira therefore rejected mere rote teaching. Far from what is usually thought about education in those years, both he and his colleagues were well aware that teaching should not be reduced to the retention of ideas that are not understood, as Manuel Mindán expressed years after his teaching at Ramiro de Maeztu (2001, p. 85):

We did not try to cram the pupils with too much knowledge. We were in favour of the maxim *non multa sed multum*: teach what is essential and fundamental, well-structured and ordered, and be sure that the pupils would assimilate it. For this reason, we avoided memorisation, that is, making them learn anything they had not already understood. In short, that they should learn things and not words, that through explanations and readings they should learn to go to the natural, cultural or social reality, depending on the case.

An example of this can be found in these words of Alvira for teacher training (1965):

It is necessary that the study of Geography should not be reduced to remembering or pointing out rivers, mountains, capes, etc. on a map. The pupil must be put in relation to the geographical fact and all possible consequences must be drawn from it. Human geography will bring them into contact with a series of realities that will undoubtedly attract them. For this reason, the data presented in this article, skilfully handled by the teacher, can be useful in the teaching of Geography at school, as this subject should be taught nowadays (p. 24)

In this field of geography, his textbooks were praised by the famous scientist Lluís Solé i Sabarís:

How to solve these problems? You have solved them, I see, guided by the pedagogical imperative. And your book is exemplary in this respect, and I find it exactly suited to the age of the pupil in terms of the extent and intensity of the knowledge. In the pedagogical aspect your book is undoubtedly far superior to all those that have been published. It is a magnificent lesson for the ministry (quoted in Méndiz, 2022, p. 240).

For Tomás Alvira, it was not only the interrelationship between the various disciplines of knowledge that was important, but also the relationship between theory and practice. Thus, in the book prepared for teachers of the 6th year of primary school, Alvira and his colleagues (Alvira; Martín; Oñorbe; Ruiz, 1972) gave the instruction that "experimental sciences are not a compartment with no relation to the outside world, but, on the contrary, their study should lead us precisely to an understanding of the world around us. Therefore, pupils must learn to link the knowledge they acquire with the world in which they are immersed, and which raises so many questions" (p. 4).

This is why he created the so-called *Aula-laboratorio* (**Classroom lab**) at the Ramito de Maeztu Institute, where students could fully approach natural sciences. We will talk about this initiative in the next section, but it should be noted here that it arose as a response to Alvira's felt need to apply a pedagogy that combined theory and practice as a whole. On the other hand, this pedagogy was not to be satisfied with the acquisition of theoretical knowledge. As we saw above, for Alvira, education should have a positive impact on the ethical and social field. This can be seen, for example, in the promotion of environmental awareness, as can be seen in the following text from one of his schoolbooks (1975, p. 107):

While it is true that one of the aims of geology is to maximise the use of natural resources, it is also true that this must be done in the most rational way and with the least possible disruption to nature and the landscape. Nowadays, public works are already being carried out with the least possible damage to the landscape, for example, the concrete of dams is covered with materials that harmonise with the colour of the landscape (this has been done in some Spanish reservoirs). In the vicinity of motorways, vegetation is planted which, in addition to protecting the soil with its roots, constitutes a decorative element of the landscape.

Finally, it should also be noted that Tomás Alvira proposed interdisciplinarity with history. An example of this is the book for the 8th year of primary school which he prepared together with some of his colleagues (Alvira; Martín; Oñorbe; Ruiz, 1974). For example, topic 10 of the book (devoted to the

structure of the atom) begins by talking about how mankind had understood electricity in the past, up to the time of J. J. Thomson and how he discovered electrons. It is certainly a very appropriate way of introducing the young student to a subject that can be difficult to understand. This value of the History of Science for the teaching of Natural Sciences is still claimed as an important task for a better pedagogy of Natural Sciences: "Science should be taught at every level, from the lowest to the highest, in a humanistic way. By which I mean that it should be taught with a certain historical understanding, in the sense of biography, the nature of the people who made this construction, the triumphs, the trials, the tribulations..." (Holton et al., 1971, quoted by Contreras; Valle; Pedraza, 2021, p. 98).

## 7. The Classroom lab or Living classroom

Based on the seminar organised together with his colleague Rafael Ibarra Méndez, Tomás Alvira created what he called the *Aula viva* ("Living classroom") or *Aula-laboratorio* ("Classroom lab"), which is perhaps his most innovative pedagogical contribution (Ripollés, 2014, p. 191). The education inspector Carlos Vidal Box praised this initiative, which deserved attention even from foreign professors, such as Otto Engel of the University of Cologne (Méndiz, 2022, p. 188). He also provided numerous practical exercises for students in his textbooks and systematically compiled activities which teachers could carry out in the classroom or which could be given to students as homework (vid. Alvira, 1952).

According to Alvira, "the formative value of the Natural Sciences stems from the contact that the student has with the beings he has to study. Natural sciences that are studied only in books lose all their formative value" (Alvira, 1956, p. 32). This Living classroom should not be, for Alvira, a mere complement to the theoretical class, an activity to be carried out on a day other than the "important" class. On the contrary, the teacher was to supervise the work of each student and, using slides, to make the theoretical explanations as the student was doing the practical task, such as, for example, the dissection of an animal. Professor Alvira

was aware that such a methodology could be perceived as unfeasible due to the time it would require. In view of this, he defended this way of teaching with the following words (1958):

This observation should become more and more precise until the schoolchildren are able to appreciate small details of the beings they contemplate, thus developing their capacity for observation, a more complete knowledge of the beings they observe, at least in their morphological aspect, and, as a consequence, a growing affection for the Creator's work.

It may seem, perhaps, that there is a waste of time if enough Natural Science classes are devoted to the simple contemplation of minerals, plants or animals, and yet we dare to affirm, after many years of experience in this sense, that this simple observation is much more effective than the acquisition of knowledge taken from a book and which never gives the pupil an image of the being studied, as his direct vision gives him (p. 27).

In 1956, Tomás Alvira described in an article what the Classroom lab he had created in the Huérfanos de la Guardia Civil Infanta María Teresa was like "for what it might be useful for other secondary schools" (p. 33). Vidal Box echoed this methodology and gave it as an example of what should be generalised in Spanish schools. Thus, he said that "the Classroom lab was first carried out, with extraordinary success, by Professor Dr. T. Alvira, at the Huérfanos de la Guardia Civil Infanta María Teresa School in Madrid. At present, this type of classroom has been generalised and perfected in various centres, such as the "Ramiro de Maeztu" Institute in Madrid" (1961, p. 1.047, n. 1); this same laboratory was also the work of Alvira and is still in use today. Thus, Professor Patricio Gómez Lesarri, Physics and Chemistry teacher at IES Ramiro de Maeztu, in an interview in that same laboratory, points out how this institute has been at the pedagogical forefront in Spain and Europe<sup>5</sup>, including undoubtedly that space which, to this day, continues to be used and updated with new methodologies and tools.

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<sup>5</sup> IES Ramiro de Maeztu, at <https://mediateca.educa.madrid.org/video/zj1y3x8bn8gh1ebw>, accessed December 2023.

Vidal Box reproduced in his article the Classroom lab schemes that Tomás Alvira himself had shared in his 1956 article, with a detailed description that could be reproduced by other schools. As a complement to these contributions, Tomás Alvira offered in his textbooks many examples to be applied in the Living classroom. An example of this can be found in the textbook he wrote for the first year of Baccaulaureate (1975). In topic 10 ("Internal geological processes IV: Minerals of internal origin") a complete description of various minerals is given, which, for a student, is certainly a challenge, because if there is no more than a theoretical explanation, it is more of a simple memorisation exercise than anything else. For this reason, at the beginning of the subject, Alvira addresses the student so that the lesson can bear the desired fruit (p. 89):

The following are slight descriptions of the main minerals of internal origin.

With these descriptions we only intend to give you a little information about some aspects of these minerals, since the knowledge of each one of them must be acquired based fundamentally on your own observation.

The observations made will be compared with the descriptions given here and with those that you may read in other books, and through these small investigations of yours, the most outstanding characteristics of the minerals, which are the object of this Unit, will be engraved in your memory.

It is by no means our intention that you should make a purely rote study of the descriptions given below.

Thus, Tomás Alvira, together with Rafael Ibarra Méndez, directed the Natural Sciences seminar of the Institute, meeting regularly to evaluate the progress of the classes, prepare the necessary materials for the explanations in advance, help the opposing teachers and organise excursions for the students to collect minerals, plants and animals (Mindán, 2001, pp. 100-101).

It is appropriate to include here the testimony of a student of Tomás Alvira (called Cornelio Abellanas Oar), as a reflection of the pedagogical impact of the classroom-labotario at IES Ramiro de Maeztu<sup>6</sup>:

I enjoyed and learned a lot both in 5th grade and in Preu. His speciality was Soil Science and I still remember him explaining to us the importance of trace elements in farmland. He spoke very slowly and clearly, walking around the tables and it was easy to take notes from him. We did quite a lot of practicals during the course and there are anecdotes that I have not forgotten.

Each practice was a new surprise. One day when we arrived in class, the two pylons at the back of the classroom were full of frogs the size of a fist: one for each of us. We saw how the blood circulated through the capillaries in the interdigital membranes with a binocular magnifying glass [...] We used the microscope a lot and learned how to make preparations of plant tissues.

I became very keen on biology. I got my father to buy me a microscope (I remember it was a Roan brand) and I made myself a microtome with the Meccano to make sections of leaves and stems with a razor blade (I don't remember the substitute I used for the elderberry pith). If it wasn't for my love of mathematics and technology I would probably have ended up in Biology.

We taught in the science lab [...] The level of biology we studied in Preu was very useful to me in the Selective subject I took with Rafael Alvarado at the Complutense. I learnt many of the vital mechanisms: chlorophyll function, the blood system, digestion, the immune system, etc. from D. Tomás with such rigour and clarity that I still have some of them half a century later.

Today I try to apply some of the biological self-monitoring systems in industrial processes and administrative management, but we still have a long way to go to imitate Mother Nature.

The testimony of another former student, Ignacio Gómez de Villalobos, is also on record: "It will no doubt no longer be adequate for modern research [referring to some aspects of the classroom], but it was, once again, an example of what this place had been, a place that was characterised by incorporating the practical teaching of certain science disciplines into its programmes, long before

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<sup>6</sup> Retrieved from <http://tomdupmor.blogspot.com/p/tomas-alvira.html> accessed October 2023.



this was achieved in other Spanish institutes"<sup>7</sup>. With these testimonies, we can conclude that the implementation of the Living classroom methodology had satisfactory results in the learning process of the students.

## 6. Conclusions

We can conclude that, in Tomás Alvirá's view, education was not conceived as isolated disciplines, but rather they should be interconnected, making interdisciplinarity perhaps the most notable contribution of Tomás Alvirá's pedagogy. This interdisciplinarity is not limited to a unified teaching of Natural Sciences (connected in turn with disciplines such as history, philosophy, or religion) so that the student acquires a unified knowledge of reality and the material world (from the smallest units of matter to the system of living beings), but it extends to the formation of the person to achieve a successful life in the professional, personal, and social spheres, with great importance placed on the family in this process. Finally, the combination of theory and practice in teaching is, for Alvirá, something essential, not conceiving practice as a mere complement to theoretical content, but as an integral part of learning. All of this is possible based on his integrative vision of the various spheres of human life and an attitude of openness towards different ideological positions, thus creating a common space that allows for a harmonious communal life.

As far as the figure of the teacher is concerned, we see the importance given to Tomás Alvirá in his solid intellectual training in his field, combined with pedagogical training and coordination with his other colleagues, so that an adequate school organisation is necessary to meet all these objectives.

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<sup>7</sup> Retrieved from [https://documentos-ramiro.blogspot.com/p/testimonios\\_17.html](https://documentos-ramiro.blogspot.com/p/testimonios_17.html) accessed October 2023.

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