

Developmental Approach in Natural Sciences: Difficulties and Opportunities in Curriculum Implementation

Igballe Krasniqi – Cakaj¹, Besa Krasniqi¹ & Burbuqe Kurtaj – Bajrami¹

¹ College of Medical Sciences “ALMA MATER EUROPAEA, CAMPUS “REZONANCA”; Prishtina, 10000 Kosova

Correspondence: Igballe Krasniqi-Cakaj, College of Medical Sciences “ALMA MATER EUROPAEA, CAMPUS “REZONANCA”; Prishtina, 10000 Kosova. ORCID ID: <https://orcid.org/0009-0003-2777-4540>

E-mail: igballe.cakaj@rezonanca-rks.com, igballecakaj@gmail.com

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Abstract

The reform of the educational system requires a developmental approach in the implementation of the curriculum. The aim of the research is to present aspect in the teaching of natural sciences, to identify the challenges and innovative opportunities during the practical implementation of the curriculum. The research is both quantitative and qualitative. It was conducted with 240 participants, including teachers (educators, trainers, coordinators) and principals, across 60 pre-university schools in Kosovo. For data collection, questionnaires with ready-made and comment answers were used, as well as interviews with principals. Participants involved in the research were asked to analyze 10 questions, with answers ready for analysis (positive or negative and to provide comments), based on key curricular issues such as: competencies, the developmental integrative approach, curricular load, or other factors. The research results at the four levels have shown aspects of the developmental approach with positive responses as follows: at the preschool level, it is 21%, at the primary level 17.71%, at the lower secondary level 21.57%, and at the upper secondary level 14%. The total data gives 18.96%, indicating positive opportunities in the continuation of the curriculum implementation. The study identified difficulties in the curriculum development approaches in 81.03%. Teachers presented obstacles in the process such as: curricular load, didactic materials and limited time, while principals highlight issues such as working conditions, professional development of staff and increased institutional responsibility. According to research, the developmental and integrated approach refers to progressive opportunities, with changes in teaching strategies and additional commitments, to eliminate obstacles to curriculum implementation in natural sciences, improve results, and increase student interest.

Keywords: developmental approach, curriculum, natural sciences, teaching, opportunities

1. Introduction

The developmental approach to the implementation of the CF until 2013-2014 and the results of implementation after this period till now, have shown that the Kosovo Curriculum Framework requires permanent commitment to achieving basic competencies in students and enabling them to learn throughout life, increasing the quality of teaching, as well as the effective organization of the school to build an education system that contributes to socio-economic competencies. The implementation of the New Curriculum of pre-university education requires adherence to the principles of the curriculum, the understanding of the decomposition of learning outcomes into competencies in the curricular areas of the first, second, third, fourth, fifth and sixth curricular levels (Scale 1, Scale 2, Scale 3, Scale 4, Scale 5 and Scale 6). The applicability and development of programs in curricular areas, especially in the field of Natural Sciences, as well as new methodological and practical aspects for the assessment of student achievements (MASHT, 2016a).

2. Literature Review

2.1 The Importance of the Developmental Approach in the Curriculum

Natural sciences represent the curricular field that offers students the opportunity to develop an understanding of concepts, theories, and laws in natural phenomena. In grades 1 and 2, students will learn about the natural environment and the human-made environment. In Scale 3, and Scale 4, teaching is carried out in subjects

(physics, chemistry, biology) aiming for an integrated, inter-curricular approach. In grades 5 and 6, in general schools (such as gymnasiums), natural sciences are taught in separate subjects (physics, chemistry, biology, geography, and astronomy) (MASHT, 2016b).

The developmental approach requires that teachers and curriculum developers organize the curriculum around common learning themes across all disciplines. For example, an interdisciplinary lesson on various phenomena such as global warming could include several subjects such as mathematics, chemistry, biology, physics, and geography.

Regarding the developmental approach to teaching in the curricular field of natural sciences, studies/research have been conducted by various international authors, while in the local context this topic has not been researched enough or has been mixed with the professional development of teachers.

The implementation of teacher training programs should reflect the development of new approaches for the realization of effective teaching with students and the modalities for their development. In some countries, such as Albania, professional development is primarily based on personal initiative and lacks support from educational institutions (Xhomara, N., 2018), which complicates joint initiatives between schools and the development of professional competencies (Musai et al., 2004). Teacher education programs should develop teachers' competencies to critically analyze, adapt, and design materials to make them more inquiry-oriented (Duncan et al., 2010).

2.2 TPD (Teacher Professional Development) and Understanding the Collaborative Developmental Approach

TPD (teachers' professional development) involves the inclusion of opportunities for active learning of new teaching strategies and other professional learning activities, including formative teacher evaluation (Archibald et al., 2011).

One of the key issues addressed in various studies, which is crucial for the implementation of a new curriculum, is understanding the powerful impact of collaboration among teachers. Learning often occurs accidentally and unintentionally, as participants become part of a community of practice (Wenger, E., 1998). Members of a community need to be informally connected to share what they have learned through their mutual engagement in school activities. Sharing experiences is an aspect of development around issues or practices that are of mutual interest to all practitioners, such as a group of teachers (Colleen et al. 2009).

The curriculum framework promotes holistic learning, which reflects the interdependencies of nature and the human-made world with the knowledge and information that students have (MEST, 2016). Meanwhile, the developmental approach to teaching includes teaching practices, skills, and strategies suitable for developing learning during the implementation of the curriculum. The integrated approach in teaching natural sciences can be appropriate for students in utilizing scientific knowledge as a tool to solve real-world problems and improve conceptual understanding (Venville et al., 2005).

2.3 The Theoretical Aspect of the Developmental Approach and Critical

Regarding the theoretical aspect of the developmental approach in the theoretical context, there are three curriculum theories identified by Ellis: knowledge-centered/academic, student-centered, and society-centered (Ellis, A. K., 2004). This research is primarily based on student-centered curricula, which focus on individuals and on the goals and interests of the individual. The fundamental basis of a student-centered curriculum is individual growth and development. The role of the teacher is to have a developmental approach using the interests and needs of students, to be oriented in a demanding and innovative way to offer students what they are looking for, becoming competitive with the latest achievements in science and beyond.

Curriculum theorists speak of two types of curricula: one in which school subjects are kept close to their original disciplinary boundaries (for example, history-geography or biology-chemistry); and another where disciplinary boundaries are more blurred for example, an inter-curricular thematic development approach. The second type of curriculum is often referred to as an integrated curriculum and is more common in early childhood and primary school education (Mutch, 2019).

There are three broad objectives in natural sciences subjects related to the development of science learning: to do science, to understand the content of the subject, and to create connections between understanding and the application of science in everyday life.

According to the authors (Dillon et al. 2015), differentiating, or modifying content and teaching strategies to suit students is much easier using an integrated curriculum, flexibility built into the curriculum structure, and integrated authentic content from real life.

2.4 Relating CF Implementation to Hypothesis Solutions

The aspects of the developmental approach to teaching aim to connect the theory learned in the classroom with knowledge and practical experiences from real life. The importance of the research is related to identifying aspects of the implementation of the curriculum, establishing critical links between subjects, and creating more holistic learning and mastery of competencies. The research has included linking teacher practices to the successful implementation of the Curriculum Framework, looking for these hypothesis solutions. To what extent has creative teaching using the developmental approach been implemented in the field of natural sciences? How does competency-based teaching help the implementation of the CF and how does practical learning facilitate teaching and learning? To what extent has the curricular load influenced the implementation of subject programs? What are the challenges and difficulties you have faced during the implementation of the curriculum?

3. Method

The purpose of the research was to examine aspects of the developmental approach to teaching natural sciences, identify difficulties and innovative opportunities during the practical implementation of the curriculum in pre-university education in Kosovo. Through this research, we also aimed to understand the role of teachers as reformers of the education system, the engagement of principals in managing the implementation of new policies, as well as the challenges that the latter face in their daily lives.

The research was conducted through a mixed, quantitative and qualitative research approach, linked to identifying (diagnostic) findings. The data were obtained through questionnaires with educators, natural science teachers (at all levels), and school principals. The quantitative approach was carried out through survey questionnaires, while the qualitative approach was carried out through semi-structured interviews. The data obtained were analyzed, processed and interpreted through tables and charts.

3.1 Research Instruments

The population (all teachers in Kosovo), of them the sample consists of 28 educators, 83 primary school teachers, 89 lower secondary school teachers, 30 upper secondary school teachers and 10 school principals (N=240). The questionnaires were conducted with focus groups involving 5-10 participants.

3.2 Data collection Procedure

For data collection, a questionnaire was used as the basic research instrument. The questionnaires contain data on the relevant qualification, level of teaching. All information obtained is completely confidential. Ten (10) questions were given in the forms, requiring the result in forty (40) ready-made answers. Nine (9) of the specific questions are closed, with ready-made answers for easy understanding and accuracy in compliance/approval of the answers. Question 10 is open-ended, where participants are required to provide individual comments and ideas in response.

3.3 Demographic and School Background Variables

The research is planned to be carried out in March, April, May and June 2023 in 60 schools, in rural and urban settlements, (35 schools in the municipalities of Prishtina, Prizren, Ferizaj, Mitovica and 25 schools in Suhareka, Malisheva, Dragash, Klina, Skenderaj). The questionnaires were sent to the research participants via email, were completed and individually returned via email by the educators and teachers.

3.3.1 Interviews with the Principals of the Schools

The qualitative part was conducted by talking to 10 principals via phone and email, providing the necessary explanations regarding the importance of the research, interviewing and accepting their suggestions. The questionnaires were also sent to the principals to familiarize them with the purpose of the research. This approach has helped facilitate communication with the schools.

4. Results

4.1 Statistics and Data Analysis

The data from the research are presented below in graphical and tabular form, adjusted to fit the requirements of the questionnaires. The results of the data reflect the level of implementation of new/innovative approaches in the New Curriculum of Kosovo, with a focus on natural sciences. These data present the results of pre-approved/positive or disapproved/negative responses from 240 participants, including 28 educators, 83 teachers at the primary level, 89 at the lower secondary level (LSL), 40 at the upper secondary level (USL), and 10 school principals.

Table 1. Number of educators, teachers and principals by educational levels and the total of approach positive and approach negative responses in %

EDUCATORS/TEACHERS	PRE-SCHOOL LEVEL	PRIMARY LEVEL	LOWER SECONDARY LEVEL	UPPER SECONDARY LEVEL	Total data
In total:	Educators: 28	Teachers and principals: 78+5=83	Subject teachers and principals: 86+3=89	Subject teachers and principals: 38+2=40	240
Total Responses	1120	3320	3560	1600	9600
Percentage %	11.66	34.58	37.1	16.66	100%
Approach positive Responses	236	588	768	229	1821
Percentage %	21%	17.71%	21.57%	14.31%	18.96%
Non-approach negative responses	884	2732	2792	1371	7779
Percentage %	78.92%	82.28%	78.42%	85.68%	81.03%

In Table 1, it can be seen that from the number of 240 participants in the research according to levels, it was requested that all participants in the research should adopt a positive approach, 9600 responses addressed as follows:

- Positive approach 1120 or 11.66% educators.
- Positive approach 3320 or 34.58 %, primary level.
- Positive approach 3560 or 37.1% lower secondary, and
- Positive approach 1600 or 14.31 %. upper secondary.

The data in Table 2, presents 10 questions. In 9 questions we have data for 36 responses of 4 levels and in total, received from 240 participants in the research (educators, teachers and principals), while question 10 presents individual comments from the mentioned groups.

Therefore, out of the total number of responses that have a positive approach, 1821 or 18.96% are positive. While 9600 or 85.03% of teachers do not have a positive approach, they have difficulty commenting on the responses for implementing the curriculum.

According to the data we have this result:

- Positive approach 236 responses or 21% of educators.
- Positive approach 588 responses or 17.71% of primary
- Positive approach 768 responses or 21.58% of lower secondary and
- Positive approach 229 responses or 14.31% of upper secondary.

Table 2. Tabular presentation of 10 questions on 5 levels, the results of approach positive responses for each question

Nr.	Questions addressed	The number of approach/positive responses from: educators, teachers, and principals according to levels and percentage (%).					Answers: Appr/Pos & Disapp/Neg in %
		Answers: Apr/Pos & Disapp/Neg	Pre-school level	Primary level	Low Secondary level	Uper Secondary level	
1	How can you show that students in your subject have achieved the learning outcomes according to the CF?	Apr/Pos.	(31)	(70)	(96).	(27)	23.3
2	How well are the concepts adapted in the curriculum area and in the subjects during the implementation of the CF?	Apr/Pos.	(28).	(62).	(79).	(25)	20..20
3	How much does scaling help implement the CF and how much does it facilitate learning and developmental practices in teaching and learning?	Apr/Pos.	(29).	(63)	(88).	(23)	21.14
4	What student achievements are included in the implementation of the CF through the realization of competencies?	Apr/Pos.	(23)	(66)	(78).	(26)	20.10
5	To what extent has quality teaching impacted student success?	Apr/Pos.	(19)	(63).	(73).	(25)	18.75
6	To what extent has it been possible to develop students' creativity in natural science subjects?	Apr/Pos.	(27).	(62).	(80).	(26)	20.31
7	What are the difficulties in linking competences and learning outcomes?	Apr/Pos.	(21)	(76).	(74).	(25)	20.41
8	How relevant has the connection between the curriculum and daily life, as well as the interests and motivations of students, been?	Apr/Pos.	(18)	(56).	(87).	(25)	19.37
9	Is the monitoring of the implementation of the CF properly planned in order to understand how teachers should develop the process?	Apr/Pos.	(34)	(63).	(98).	(24)	22.81
10	*Write some individual and independent comments as a professional teacher, based on the quality of teaching. The obstacles and advantages in implementing the CF	Apr/Pos.	6	7	15	4	20.92

5. Discussion

From the data obtained from the teachers involved in the research, we have dilemmas and avoidance of responsibility in accepting what a developmental approach to teaching is, where the results obtained show a low level.

Questions that address compliance with the answers require concrete results in the realization of competencies, since a professional and successful teacher must be a promoter of changes in his professional development and the methodology of research in action. According to the authors, the developmental aspect of practical and experimental learning of an integrated curriculum is facilitated through service learning (Drake et al.2004), service learning is not suitable for every subject or course, but can be effective in any discipline (Jacoby et al.2015). Service learning works well for students with a wide range of learning styles, from theoretical students, who learn best through abstract conceptualization, to those who learn best from active and concrete experience.

This way of learning is applicable even in limited conditions, such as in the previous years of the Covid-19 pandemic, i.e., utilizing different learning styles.

Another aspect of the developmental approach of the study is related to the implementation of the curriculum, which aims to identify how teachers have difficulty in linking competences to the LOS. This is addressed by question 7; What are the difficulties in linking competences and learning outcomes? This represents the link to the competence required in achieving specific learning outcomes according to the subject or the results of a chapter. Some of the responses clarify how relevant the successes and obstacles were. A data that explains the procedures of solving problems in several different techniques, that not every solution can be found in the same way, can reveal students' persistence skills in chemistry. For example, mathematics should complement the conceptual understanding of chemistry (Vulaet al., 2022). A study evaluated as a developmental approach to the implementation of teaching in integrated subjects.

The results show that the curriculum area of natural sciences includes research in action as a developmental approach, new scientific ideas or resources, the development of student skills through projects and models, so that they become skilled as creators open to new ideas and the world around them.

Some of the teachers involved in the research agreed with the key issues, providing comments on the challenges they face during the implementation of the natural sciences curriculum, but also the advanced opportunities/advantages offered by the new curriculum. The majority did not provide the necessary contribution and attention to the importance of the study, expressing a positive opinion in only a few responses.

The answers to question 9 are given in the form of questions, which means that during the monitoring: were the tasks assigned for the implementation of the CF fulfilled, and the answers are yes or no. This analysis brings a different ratio between the levels, where participation is low. Thus, in most cases, the monitoring was not done professionally and teachers have deficiencies and limited information for the development and support of the competency-based curriculum.

Studies in New Zealand view the new curriculum as complex, with data showing a low level of implementation; on a scale of 0-5, the average value was 2.7 in 2008 and 2.8 in 2009 (Claira, S., 2011). This data corresponds with our research, where our results show a low developmental approach in the implementation of the curriculum.

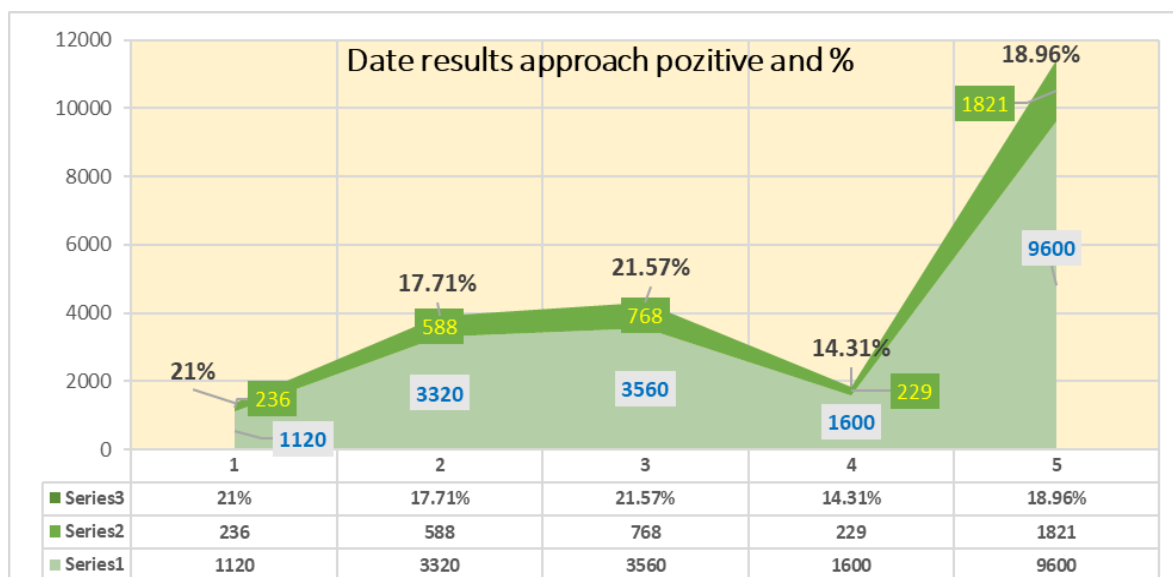


Figure 1. Graphical presentation of overall data of approach positive and non-approach/negative responses, numerical values and % according to educational levels

In Figure 1, the total number of responses that should have been approach positive (7779), 1821 or 18.96% were approach positive. From these results, it appears that 7779 or 81.03% of teachers did not provide approach positive responses, and the comments are few.

The primary level shows the highest percentage of approved/positive responses at 17.71%, while the lowest percentage of approved/positive responses is observed in LSL (lower secondary level) at 21.57%, USL (upper secondary level) at 14.31%, and PSL (pre-school level) at 18.96%.

As shown in the graphical presentation in Figure 1, we have the expected data of positive approach by levels, approved/positive responses and disapproved/negative responses by levels.

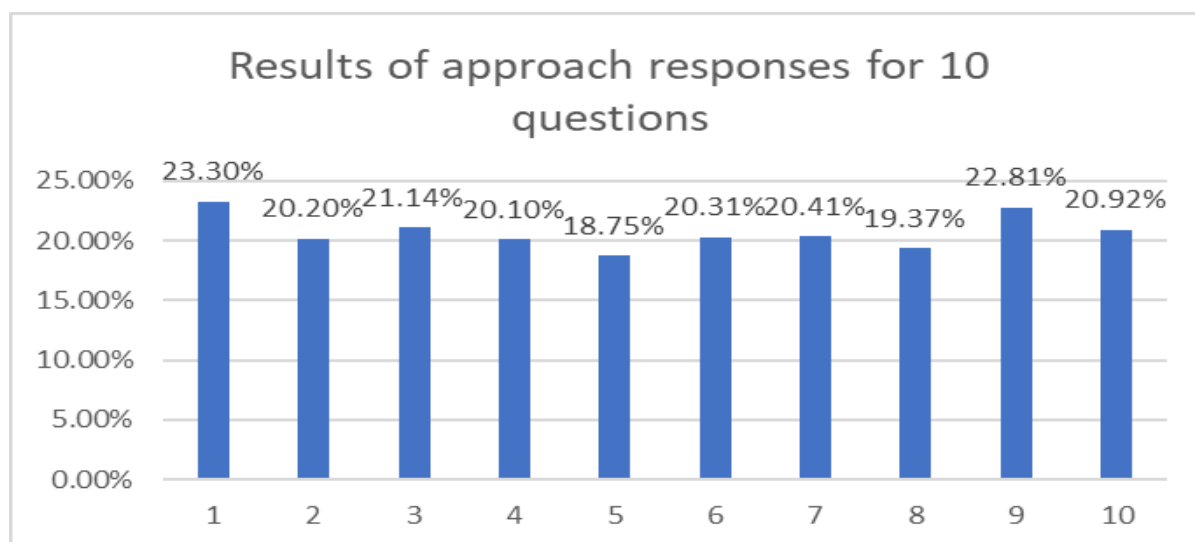


Figure 2. The number of approach positive responses from: educators, teachers, and principals according to levels and percentage (%)

In Figure 2, question 1 has the highest percentage of approved responses, 23.3%, because natural sciences should involve more creativity and application of the substantial and conceptual parts of the subject programs during the implementation of the CF. In questions 3 and 9 we have an increase in the percentage of positive responses at all levels, 21.14% and 22.81%. The responses to the other questions are approximately equal in %.

Question 4, is approved 20.1%. What student achievements are included in the implementation of the KK through the realization of competencies? Example of answers

- a) Integrated and coherent curriculum of knowledge, skills, attitudes and coping with challenges.
- b) Three elements: Content (Know), Curricular Competence (Do), Big Ideas (Understand) and Deeper Learning (Analyze).

Question 10 requires comments from the 240 participants in the research, but only a few ideas and suggestions were provided, with only 22 responses or 20.92%. Semi-structured interviews with 6 open-ended questions focused on the research objective were conducted with the principals. Most of the principals' responses are quite similar.

6. Study Strengths and Limitations and Future Research

The strengths of the study include the evidence-based data on the serious work of teachers and management staff in implementing the education reform. Where research with teachers in the field of natural sciences shows commitment to implementing subject programs, which will continue even in such a situation. This study was worked with specific groups at the school level, and analyzed their capabilities to understand their teaching situation. Perhaps the greatest limitation of the study was the low response rate in their willingness to analyze the connection between the subject plan with the Core Curriculum and the breakdown into measurable results. Difficulties during the implementation of the natural sciences curriculum have been commented on, but most have not contributed or paid attention to the study requirements. It remains in the future to focus on the results monitored by professional groups and education inspectors. This will be relevant!

Also, the research has proven that in Kosovo, the monitoring of the process of implementing the new curriculum is either missing or inadequate (carried out by individuals not from the relevant field/subject), or it has occurred rarely in schools without any professional planning, an issue that needs to be addressed by higher state

institutions.

The results show that the challenges that most teachers face are: lack of continuous monitoring, serious training, punishments for various omissions in the teaching process, as well as support for innovative teachers. On the other hand, the work and commitment of dedicated teachers may decline for now known reasons such as: the number of students, unsystematized in rural and urban areas, inadequate professional and managerial staff, and insufficient concrete tools for quality work.

7. Conclusions

This study was conducted to understand the teaching approach in natural sciences in the form of a developmental approach during implementation. The challenge is to understand the developmental processes and other aspects that make a curriculum successful, despite the difficulties during its implementation. These results, however small, remain commendable for those teachers who organize learning based on competencies according to curricular areas, teaching programs and an interdisciplinary approach.

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Appendix A

Some of the comments given by the principals' interviews

They have understood the curriculum as teaching that develops: knowledge, skills, attitudes, values of content, by reforming and transforming their knowledge into practical application in daily life, through competencies and learning outcomes: LOS (Learning outcomes by scale), LOF (Learning outcomes by field), and LOS (learning outcomes for subjects). Not all teachers have been encouraged by the implementation of the new curriculum to use new methodologies and change their teaching methods. I think that quality in teaching is achieved by using technology, concretization tools for teaching practice so that students are not overloaded only with theory. The implementation of the new curriculum should be continuous, adapting to the conditions that schools must provide. External assessment has to some extent supported teachers to change the form of student assessment, based on LOS (learning outcomes for subjects), and the development of competencies, according to the concept of the New Curriculum. Based on my many years of experience, efficiency and dedication are required in working with students. However, traditional teachers find it difficult to change.

- Challenge remains the lack of infrastructure, classrooms, concrete tools, appropriate textbooks, the large number of students in classes, etc. The textbooks drafted by MEST are very deficient and need improvement, because in our schools there are not sufficient conditions for other resources such as online learning.
- We have tried to motivate students through various practices, especially in rural areas, to achieve the results foreseen by the curriculum.
- Quality in education requires professional monitoring by competent people, textbooks adapted to the theoretical and practical needs of students, working conditions, adequate professional training for teachers, social respect for teachers and school management staff.

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