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Artículos

Designing Multimedia Learning Materials in Rural Settings Located in the Colombian Coffee Region*

Diseño de materiales de aprendizaje multimedia en entornos rurales situados en la región cafetera colombiana

Desenho de materiais de aprendizagem multimídia em ambientes rurais localizados na região cafeeira da Colômbia

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Abstract:

This article addresses the results from a research that follows the principles and methods of the qualitative-evaluative approach that intended to design, develop, and validate a series of multimedia learning materials applied to different curriculum disciplines. The study was carried out in rural schools located in an underdeveloped Colombian Coffee Region from 2018 to 2020. Guidelines, class observations, surveys, interviews, and expert assessment were the most useful instruments and sources of data. The results indicate that, given the novelty, attractiveness, and curiosity towards the use of multimedia components, rural schoolchildren acquired different levels of active learning competencies. Bearing in mind that digital divide may intensify the existing rural-urban gap, it is crucial to embrace innovative solutions to persistent problems in declining equity and quality taking into account the rural students' contexts. It is a curricular innovation providing teachers the possibility to conduct interactive, dynamic, playful, and creative classes according to the rural reality.

Keywords: Learning Materials, Multimedia, Rural Schools, Technology, Underdeveloped Settings.

Resumen:

Este artículo aborda los resultados de una investigación que sigue los principios y métodos del enfoque cualitativo-evaluativo que pretendió diseñar, desarrollar y validar una serie de materiales didácticos multimedia aplicados a diferentes disciplinas curriculares. El estudio se realizó en escuelas rurales ubicadas en una región cafetera colombiana subdesarrollada, entre 2018 y 2020. Las guías, las observaciones de clase, las encuestas, las entrevistas y la evaluación de expertos fueron los instrumentos y las fuentes de datos más útiles. Los resultados indican que, dada la novedad, el atractivo y la curiosidad hacia el uso de componentes multimedia, los estudiantes de estos entornos rurales adquirieron diferentes niveles de competencias de aprendizaje activo. Teniendo en cuenta que la brecha digital puede intensificar la brecha rural-urbana existente, es crucial adoptar soluciones innovadoras para abordar los problemas persistentes de disminución de la equidad y de la calidad de la educación, teniendo en cuenta los contextos de los alumnos rurales. Se trata de una innovación curricular que ofrece a los profesores la posibilidad de impartir clases interactivas, dinámicas, lúdicas y creativas, que sean acordes con la realidad rural.

Palabras clave: material didáctico, multimedia, escuelas rurales, tecnología, entornos subdesarrollados.

Resumo:

Este artigo aborda os resultados de uma pesquisa que segue os princípios e métodos da abordagem qualitativa-avaliativa, que pretendia projetar, desenvolver e validar uma série de materiais de aprendizagem multimídia aplicados a diferentes disciplinas curriculares. O estudo foi realizado em escolas rurais localizadas em uma região cafeeira colombiana subdesenvolvida, de 2018 a 2020. Diretrizes, observações de aulas, pesquisas, entrevistas e avaliação de especialistas foram os instrumentos e as fontes de dados mais úteis. Os resultados indicam que, dada a novidade, a atratividade e a curiosidade em relação ao uso de componentes multimídia, os alunos de escolas rurais adquiriram diferentes níveis de competências de aprendizagem ativa. Levando em conta que a exclusão digital pode intensificar a lacuna rural-urbana existente, é fundamental adotar soluções inovadoras para os problemas

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persistentes de diminuição da equidade e da qualidade, levando em conta os contextos dos alunos da zona rural. Trata-se de uma inovação curricular que oferece aos professores a possibilidade de conduzir aulas interativas, dinâmicas, lúdicas e criativas de acordo com a realidade rural.

Palavras-chave: materiais didáticos, multimídia, escolas rurais, tecnologia, ambientes subdesenvolvidos.

Introduction

During the 21st century, also called the knowledge age, the digital era, or the high-tech age, different spheres of life, including education, have been hard-pressed by the advent of modern technologies. In today's cultural contexts, special attention is drawn towards the contemporary generations that have largely grown up in the contradictory culture of technologies. Harasim (2017) points out that "our personal, professional, social and cultural lives have been affected and transformed by the computer networking revolution" (p. 2).

Nowadays, in a process of permanent change, the integration of technologies into the school curriculum becomes an alternative for academic reforms at all levels and modalities of the educational system taking advantage of the high-quality accreditation policies. Progress has been made in the construction of technological tools and repositories. Faculty members, researchers, students, and experts from across disciplines are constantly thinking of how to work collaboratively by using digital resources and tools. Images that contain information mediated through digital tools that provide interactivity, creativity and innovative ideas abound.

Among the most useful multimedia materials via classroom projects are mentioned: primers, charts, e-books, booklets, artifacts, instructional guides, handbooks, games, tasks, quizzes, chats, discussion forums, workshops, virtual environments, and all sorts of active learning strategies. The design and development of this type of materials has had an impact on the creative processes of teachers and students, thanks to the advances in information and communication technologies (ICT) within pedagogical environments that emerge in the globalization age. It has also been shown that its impact extends to the cultural, economic, social and political dynamics of the unstoppable transformations of the 21st century, which have a constitutional basis (Posada & Giraldo, 2023). That is why institutions justify the need to appropriate resources as well as to invest time, and adjust technological infrastructures.

It is crucial to update curriculum reforms and create all kinds of interactive materials according to the characteristics and complexity of the students' ages, interests, competencies, and learning styles taking into account the socioeconomic and cultural backgrounds of the populations.

Nevertheless, adapting the inevitable shifts to the personal, social and cultural characteristics of students and teachers has been a difficult and controversial task. Teachers and students would renew the way they work and encourage the schools to reach the educational goals for the third millennium (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2014) and explore new educational paradigms rather than merely change common tendencies through adding technology onto traditional methodologies. Harasim (2017) goes even further to critically study the intersection of effective online environments and learning outcomes, addressing the need for an epistemological view of teaching, learning, and communication to the present day characterized by a technology-driven world.

Modern technologies can be useful for a better teaching and learning process in the rural sector. However, rural areas have unique needs and are lagging behind the accelerated advances of science and technology. They need to increase the use of digital technologies with the aim of acquiring skills and abilities to learn, to teach and to live together in the global village (UNESCO, 2014).

Most Colombian public institutions are open to innovative proposals helping students succeed in their learning process. Yet, it was not until the last two decades that the national policies have been promoting research groups, lines, and large-scale projects in such a way that socially impact the urban and rural sectors.

Schools, high schools, and universities are showing a substantial growth in the use of computers, which in turn increases teachers' interest on digital literacy, getting a closer connection between information, research, and knowledge. This is the case of the lines focused on multimedia, virtual tools, blogs, web pages, platforms, hosting, tutorials, interactive materials, internet formats, databases, and intelligent learning environments. This family of technologies has been effective to promote learning in different teachable disciplines, pedagogical contexts, and learning styles, as required by the pedagogy of the 21st century.

Bearing in mind that digital inequality may intensify the existing rural-urban gap, new strategies should be explored. Within the rural settings, it is crucial to embrace innovative solutions to persistent problems in declining equity and quality, limited budgets, academic offerings, and digital divide, taking into account the rural students' contexts. As Liao, Chang, Wang and Sun (2016) put it "to increase computer availability can reduce digital divide of students" (p. 123).

Although the number of technological devices in homes and schools, as well as the capacity of computers rooms or laboratories, internet connectivity, and the amount of weekly electronic classes play a significant role, it is remarkable to say that, unfortunately, the implementation of modern technological processes is limited by different factors that directly or indirectly determine the quality assurance of rural education, such as:

- A high percentage of rural students come from poor income families in which both illiteracy and lack of computers are common.
- It is difficult for rural institutions to deal with sophisticated types of digital technologies which appear to be missing.
- The teacher's voice, photocopies, pencil and paper, sheets, notebooks, printed workshops, maps, board, and the like are the traditional materials frequently used in the classroom.
- Scarcity of scenarios specifically designed, and, if they exist, they are very few or underexploited.
- Schools do not always have the qualified personnel, good lab conditions, Internet connection, electrical energy and other basic resources and strategies they need to carry out educational projects.
- Most rural teachers still struggle with technological tools that may entail skills other than those they regularly use.
- The available didactic resources are not always reachable due to their location.
- Extraneous prejudices that usually delay the implementation of digital gadgets in rural schools may discourage teachers, parents, and children. For instance, some rural families still see the use of mobile devices and computers as a menace, whereas urban citizens may use them as a valuable artifact.
- Lack of different attractive materials (e. g., drawings, games, music) whenever they determine the levels of attention, creativity and motivation from the students.
- Rural people complain that their enthusiasm and eagerness to teach are diminished because the academic communities do not see the technological environments as exciting places to learn in their daily life.

Thus, serious difficulties emerge when using technologies linked with computers to design curriculum lessons to each specific rural context located in underdeveloped countries. Of course, it is impossible to overcome all the constraints that computers pose to work in today's rural classroom.

Despite the aforementioned restrictions and real situations, improving instructional methodologies that recognize the importance of specific rural conditions is a prime necessity. It is demanding for rural schools to provide teachers with renewed strategies and effective materials they bring to their classrooms. Regardless of the pros and cons of modern technologies, these are unavoidable components of schooling life, and therefore their implementation in curricula innovations become essential. That is why creating attractive multimedia materials integrated into the rural school curriculum remains an imperative research issue. What the school

staff should do is to identify strengths and *weaknesses* so that all together can create or readjust better learning tools.

Hence, it is compulsory for teachers and the rural community at large to build up modern repertoires of possibilities that equip them to cope with the most attractive tools and innovative methodologies. Including them in technological repositories would be a very important and beneficial academic solution to deal with classroom challenges that meet the expectations and cultural trends of the 21st century rural youth.

In line with the prior concerns, the following research questions were posed:

- What are the technological and pedagogical processes to design multimedia learning materials aimed at rural classrooms?
- How do rural schoolchildren interact with multimedia learning materials?

Consequently, the following objectives were framed:

- To design multimedia learning materials and to validate their relevance in rural classrooms.
- To examine the extent to which multimedia materials favor or not the rural schoolchildren's learning.
- To identify the technological and pedagogical processes for the construction of interactive learning multimedia materials in Colombian schools located in rural regions.

Conceptual Change and the Use of Technologies in Education

The literature review in the 21st century shows some theoretical, methodological, and procedural contributions recognizing that educational changes have been strictly tied to the current use of emerging technologies in an interdisciplinary perspective. Different authors go on to support that the appropriate use of digital technologies with social benefits becomes a challenge and demands ingenious solutions. Englund, Olofsson and Price (2017) speak about the conceptual change and progress concerning the use of technology in education during the last century as a key element of professional development for both novice and experienced teachers. Moving into a holistic vision, Warren, Lee and Najmi (2014) explain the impact of important shifts and implications of technology on the field of instructional practices.

In this line of action, Cortada (2008) illustrates how computers have efficiently changed the work of industries and economies. Serrat (2017) presents knowledge and the creative use of available technology as a key to build and enrich learning organizations, as well. Aubrey and Dahl (2014) gather evidence on the use of technology from parents, family members, and practitioners. They show that most young children are positive and actively involved in media-rich digital environments through socio-cultural contexts. Howard, Miles and Rees-Davies (2012) have found a variety of computing experiences and play-based curricula through which children perceive and show high levels of engagement. Herrera-Mosquera (2017), asserts that "It is only natural that the inclusion of computers has drastically impacted conventional classroom teaching" (p. 482). Although the media play powerful consequences in the global village, the computer has become an instrument that facilitates the development of tasks, based on information and apprehension of pedagogical processes.

That is why, the governments in different countries (Cortada, 2008) have been successfully incorporating information and communication technologies (ICT) for a better relationship between nations facing crucial challenges in the race of competition towards modernization. They have been leading their efforts investing significant budgets to implement programs, policies, action plans, and projects of short, medium or long range terms, aimed at refreshing the infrastructures of institutions and at the same time, to increase the quality accreditation ranks. In this key developmental process, few countries have done so more quickly and efficiently than others. Concerning investment for educational programs, Saltsman (2018) considers that "existing approaches have been less than effective, especially in low-resource countries" (p. 108).

Information and communication technologies are a fundamental part of contemporary pedagogical processes "which requires a teacher not only to have the ability to work with digital information, but also to possess 'soft skills"' —abilities to search and work with information, interpersonal communication, teamwork, flexible and creative thinking" (Dolzhikova & Kholina, 2018, p. 11). Information and communication technologies-based education is a successful factor aimed at enhancing cognitive processes, renewing curriculum contents, stimulating students' behavior, improving the effectiveness of materials and all kinds of educational resources. Continuing with Saltsman's rationale (2018), information and communication technologies can considerably contribute to the purposes of both teacher professional development and learners' growth in any given educational setting: "However, the number of teachers who are able to use technology effectively in these roles appears limited" (p. 108).

In light of the above considerations, computer resources and tools open the door towards new ways in the production, access, and dissemination of teachable contents as well as the promotion of students' successful learning: "Needless to say, computers and other technological devices today are pivotal instruments through which learners can access knowledge anytime and anywhere" (Herrera-Mosquera, 2017, p. 483). Thus, it is possible to incorporate in a significant way the resources and tools to improve the pedagogical processes.

Concerns about Technologies in Rural Underdeveloped Settings

In Latin American countries at large, government policies call for sound technological innovations to involve public and rural education in the trend of competitiveness in both developed and underdeveloped countries. Nonetheless, due to its very nature, rural education in underdeveloped countries have escaped the effects of the changing world from the global society in terms of interdependence, participation, dissemination and active use of knowledge. A special reference is made to Colombian rural schools located in isolated and vulnerable settings that should not be left behind the progress, science, and technology anymore (UNESCO, 2014).

With regard to the social inequality that intensifies the existing rural-urban gap between rural and metropolitan sectors (Bauch, 2001; Liao et al., 2016; UNESCO, 2018), much of the decision-making does not take into account specific necessities. State policies are focused on metropolitan regions supporting the most prestigious institutions. Compared to larger urban or private schools where currency provisions for technology may be readily obtainable, in general terms, rural schools are vulnerable when reproducing the development approaches of urban ones. Poverty, illiteracy, families' educational level, health care, schooling practices, communication systems, trade, nutrition, culture, behaviors, goals, expectations, believes, lifestyles, and human values are dramatically different from their urban counterparts. Additionally, the socio-environmental conflicts linked to the crisis of the planet cause a negative impact on ecosystems affecting rural communities even from the legal and juridical regulations.

In the case of the Coffee Region, which was taken as the cultural, geographical, economic, social and educational setting of this research, Munévar et al. (2024) refer to current challenges such as the participatory and symbolic dynamics that emerge when it comes to describing contexts and dealing with conflicts related to territorial planning, political intervention rights, citizen participation and access to environmental justice, among others. All these challenges involve rural schools and have a normative, legal and jurisprudential theoretical framework applicable to the management of the national educational system. These challenges should be reflected in the contents taught at rural schools, including the pedagogical approach, the methodological route and tools that dynamize the set of school experiences in the respective territories. Despite their vulnerable conditions, rural communities face many challenges in reaching a sound development and at the same time, they claim for greater equity in access and democratization of knowledge (UNESCO, 2014).

UNESCO (2018) shows rural-urban imbalances and points out that more than 700 million people in the world live in foreign countries: "Rural to urban migration can increase educational attainment in countries where access to education in rural areas is low" (p. 14). It is one of the biggest challenges for educational policies, because schooling is one of the main reasons for migration from rural to the biggest cities. Besides, "Rural students have only around half the chance of their urban peers of completing upper secondary education in low and middle-income countries" (UNESCO, 2018, p. 49).

Echazarra and Radinger (2019), after reviewing international research results, refer to the most common characteristics of rural communities, highlighting differences between rural and urban student's learning and expectations. The authors identified critical limitations affecting high-quality rural education such as infrastructure, teacher preparation, rural-urban academic gaps, socio-economic status favoring city students to complete a university degree. They argue that governments may take into account specific policies to increase opportunities for rural people.

Mediated Education in the Digital Age

A theoretical framework concerning a review of digital tools as mediators of learning tasks that help to acquire mental representations of abstract and concrete concepts has been outlined. According to Mtebe, Mbwilo and Kissaka (2016), "in recent years, there has been an increasing interest in the development and use of multimedia enhanced content to enhance the quality of teaching and learning" (p. 66). Experiences in this field have always focused on improving the effectiveness of resources to enhance the student's cognitive process, creative skills and self-esteem. In this regard, several studies (such as those in Mtebe, Mbwilo and Kissaka [2016], and Lee et al. [2014]) have considered that multimedia technologies are specialized systems adaptable to the specific needs and characteristics of educational contexts

The concept of mediator in education can be understood as a set of instruments, digital tools, teaching techniques, and learning strategies that serve as a bridge for the apprehension of cognitive, pedagogical, and technological processes. In advocating the modern approaches of computerized educational materials, Galvis (1993) refers to the concept of multimedia technology which favors challenging, meaningful, interactive, motivational, entertaining, and contextualized learning experiences. After a systematic evaluative process, Galvis (2001) adds that these types of materials require special professional skills and control by the users.

According to Lee, Hsiao and Ho (2014) "Multimedia learning has been defined as a learning activity that involves using pictures (such as animation) and words (such as narration) to offer a powerful tool for improving students' understanding of instructional material" (p. 120). These researchers examined how digital multimedia instructional materials significantly affect the students' emotional responses, curiosity, critical thinking and learning motivation.

Materials and Method

To design, implement, and adjust multimedia learning materials establishing their possible contributions in a rural institution is a demanding and systematic research process. For this reason, the present piece of work mainly uses elements and principles of the qualitative-evaluative approach. Most procedures and characteristics of the evaluative method are found in Escudero's (2016) definition. It is focused on collecting information to make decisions about the failures and successes of programs, plans, and projects in progress to be able to improve them, fix corrections or suspend them in due time. As for the case study methodology, the project was developed in a rural classroom during one academic period, taking into account that, according to Stake (1995), the case is an in-depth study of an event, a process, a program or a small group of people in a specific context and within a given period.

Natural observation in a real rural setting took place (Creswell, 1998; Elliott, 1991) for entailing descriptions and meanings of what students actually did in the classroom using multimedia materials. Data collected during the classes was perhaps one of the most important moments to know if multimedia materials favor or not participant's learning. Each period class lasted 90 minutes, and, in some cases, classes were extended to 100 minutes, to be taken once or twice a week. The number of students surpassed the number of machines in the system room. Three or even four students had the opportunity to work together on one computer.

To guarantee efficiency and a high level of validity, different instruments were used, such as journals, class observation guidelines, field notes, surveys, semi-structured interviews with the teachers, and expert assessment. The target group was visited twice a week resulting in a total of about 30 observations and 10 completed interviews.

Concerning the follow-up procedures, a series of seven logical stages that started from the flow of an idea until its validation, adjustments, and adaptability were carried out. It was a step by step sequence that required a systematic plan involving people, teachable contents, resources, components, tools, and information offering a range of utilities.

Stage one: A description of the rural educational context where the validation of multimedia learning materials was carried out. The analysis and understanding of the pedagogical model adopted in the institution including the cognitive activities was fundamental, as well as the characterization of curricular processes, resources, and the technological capacity of the institution's inventories used for teaching.

Stage two: description of the target population. The participants involved in the study were about 42 elementary rural students and 5 in-service teachers who were taking a master's degree program in education. Students' ages ranged from 8 to 12 years old. They came from farmer families and belonged to a low-income stratum. Different factors such as gender, physical and intellectual features, age, learning styles, previous experiences, expectations, attitudes, aptitudes, interests, motivations, academic level, and the frequency of computer use, among others, were considered.

Stage three: the work team teaching. A collaborative group including experts in different disciplines was required to create the computer-based materials covering curriculum areas such as mathematics, biology, environmental education, among others. From the birth of an idea to the delivery of its results, the process of designing instructional multimedia resources integrates methodologies, techniques, and tools from different disciplines that require interdisciplinary dialogue among its members. The group was made up of a rural head teacher, a pedagogue, a curriculum designer, a visual designer, a digital designer, a computer system engineer, and a computer system administrator, as they dominate areas that converge for the design of learning materials. These professionals interacted through a series of subjects and virtual activities adjusting them to the rural schoolchildren's conditions. Undergraduate and graduate students with different levels of knowledge were trained to participate in the role of monitors.

Stage four: selection of the teachable contents, strategies, and methodologies. These components were purposefully created according to the parameters of the official curriculum. Bearing in mind that each person learns differently, even in the same contexts, different multimedia strategies were carefully selected, according to the rural students' characteristics, paces, times, needs, and interests.

Stage five: creating the characters' profile. An adaptive environment was built for rural students with a high level of interest in digital activities taking into account the combination of different multimedia instructional components such as images, texts, scripts, music, animated characters, among others. The sketches and characters were taken from the most common drawings of the students' notebooks, such as the animals, plants, people, farms, and landscapes of a rural school context. Each character was created to develop a lesson, keeping in mind the representation of concepts, ideas, problems, and objects representing the daily life in the rural region.

The following list of lessons was organized in a sequence so that rural students, teachers and researchers proved to be effective:

Lesson 1. The buzzard taught the subject of environmental pollution
Lesson 2. The duck taught about geometrical figures
Lesson 3. The pulping machine taught the subject of coffee planting and harvesting
Lesson 4. The apple taught about healthy food
Lesson 5. The rabbit taught the subject of atmospheric changes
Lesson 6. The cow taught the subject of malnutrition
Lesson 7. The frog taught about human values
Lesson 8. The fungus taught about rural economy
Lesson 9. The flower taught the differences between rural and urban environments
Lesson 10. The Jeep (typical car of the rural region) taught the means of transportation
Samples of multimedia materials are presented in figure 1.

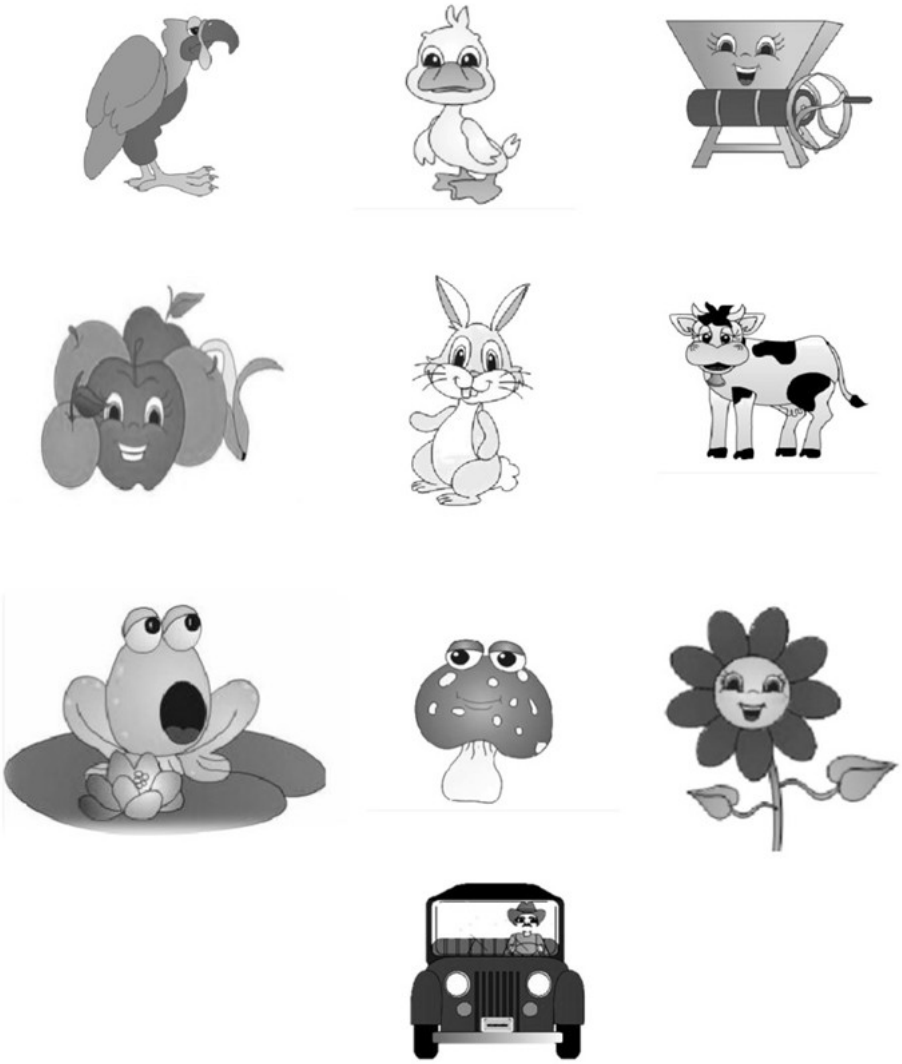

FIGURE 1.
Drawings taken from the students' notebooks representing rural context characters
Source: Own elaboration.

Stage six: virtualization of contents and activities. The contents and activities were organized and then used in the development of the virtual platform adopted by the institution. A series of conditions were

established referred to the instructional design, implementation of digital tools, multimedia development, and adaptation of the computer systems room.

Stage seven: evaluation, readjustment, and improvement. It refers to identify learning outcomes, process effectiveness, adaptability of resources, and methodologies used in the rural educational institution. The interdisciplinary group provided access to the materials, activities, or assessment sessions during or outside the lessons. They discussed the indicators and interactive activities to obtain the necessary supply inputs and to make the adjustments. It was possible to observe how rural schoolchildren and teachers reacted to the use of multimedia materials and the circumstances surrounding the evaluation stage.

A set of demonstrations and simulations among the target population were performed, following the work team's instructions to better understand how to handle the technological tools, sequences, and methodologies. The uses and misuses of these pilot material and the interactive trial and error exercises were taken into account. After correcting the most prevalent failures, new strategies, and resources were adopted to guarantee quality, relevance, and continuous improvement of multimedia learning materials in rural settings.

Results

The results intended to illustrate the experiences and successful research stages followed in the creation of a type of multimedia learning materials in rural educational settings. Some relevant data collected during the fieldwork are described below.

Table 1 contains a summary of the multimedia benefits from the rural teachers' perspectives, showing that a significant percentage of participants expressed feelings of satisfaction, motivation and successful learning interaction. The categories that describe the schoolchildren's abilities when developing the materials were previously established in the computers room observations.

TABLE 1.
Multimedia didactic benefits from the rural teachers' perspectives

Categories	Always	Some times	Never	Total
Multimedia instructional materials became an interactive product that favored personalized and collaborative work.	95 %	5 %	-	100 %
Rural schoolchildren acquired different levels of autonomous learning, according to their abilities, needs and personal paces.	80 %	20 %	-	100 %
Multimedia components such as audios, videos, images, animations, sounds, color, text, shapes, dialogue, cartoons, and games represented the rural educational context.	90 %	10 %	-	100 %
Rural schoolchildren demonstrated their competence in the management of digital materials understanding conceptual topics of school curricula.	70 %	20 %	10 %	100 %
Rural schoolchildren were able to follow instructions through computers.	70 %	10 %	20 %	100 %
When interacting with the computer, rural schoolchildren were able to interpret texts, illustrations, figures, objects and short lists of sentences.	60 %	20 %	20 %	100 %
Rural schoolchildren fully completed the tasks and activities.	80 %	15 %	5 %	100 %
Rural schoolchildren increased their levels of participation and reinforced personal responsibility.	80 %	10 %	10 %	100 %
Technological devices promoted active learning acquisition.	90 %	5 %	5 %	100 %

Participants disclosed positive attitudes towards the novelty and curiosity of technological tools.	90 %	10 %	-	100 %
Multimedia components were original and favored interaction during the lessons.	90 %	10 %	-	100 %
Using Multimedia materials through computers increased the level of motivation towards the lessons.	90 %	10 %	-	100 %
Previous experience was used as the basis for increasing the digital competence level.	90 %	5 %	5 %	100 %
Curriculum contents and activities took into account the cultural context of rural schoolchildren.	100 %	-	-	100 %

Source: Own elaboration.

The above results show that the multimedia didactic materials created by an interdisciplinary group of experts (in content, curriculum, pedagogy, and other disciplines) were innovative and well appreciated because rural schools did not have many digital technologies of support to cover curriculum topics. Interaction between teachers and other professionals was possible thanks to the characteristics of the multimedia learning materials whose main purpose was to ease, encourage, and enrich rural learning experiences.

The work team of experts stated that both students and teachers highly valued the effectiveness associated with multimedia materials to enhance learning inside rural classrooms. The combination of text, audio, images, and movement made multimedia an excellent format for curriculum areas which was planned as a good example to elicit autonomous, personalized, and collaborative learning.

Teachers' perceptions towards the use of multimedia-based lessons reinforced positive attitudes towards the novelty and curiosity of technological tools. A teacher said: "I recognize that personal experiences with image, text, sound, video, animation, shape, dialogue and color contribute to generate a more dynamic, playful and creative classroom environment".

One of the most important findings was that rural teachers were able to use technological tools aimed at facilitating strategies for preparing, presenting, and evaluating curriculum content lessons. They always took into account the students' different learning backgrounds, paces, and styles. Results indicated that the students who wisely directed their learning processes, each at their own pace, continuously developed the activities in the expected time, taking into account the characteristics and the instructions prepared for the target population.

Testimonies regarding this issue reveal what they observed during the fieldwork:

> "In my opinion, the use of multimedia materials represents a pedagogical and curricular innovation."
>
> "I can state that it is a very important, innovative and beneficial task because the academic rural community at large can be able to improve teaching and learning."
>
> "I perceive that the interdisciplinary group was able to select the resources and digital tools that were useful in the instructional processes of education in a rural sector."

As shown in the comments revealed above, compared with table 1, for most of the students (90 %), multimedia materials were a beneficial didactic means for either, working or having fun in rural schools. One of the most important advantages was getting students' attention, which may make lessons innovative, attractive, and more effective.

According to their abilities, possibilities, and needs, 80 % of the students acquired different levels of autonomous learning. The rural teachers verbally corroborated:

> "It is important to note that rural students activated cognitive processes to promote meaningful learning."
>
> "Students with novelty and personal interest interacted with content and were able to create comics and invent games and animations."
>
> "I perceived that the digital tools were useful in the instructional processes of rural educational institutions."

Although a large percentage of respondents (90 %) do not use computers at home, and the school period was short, they valued a satisfactory experience holding a positive attitude. Regarding the students' opinion, very few students (10 %) expressed feelings of disappointment owing to external problems such as family poor conditions, lack of connectivity, lack of computers at home, insufficient infrastructure, few scheduled hours per week, and the like. At the very least, interactivity allowed students to be in permanent contact with the multimedia-based lessons, even in circumstances that were not possible during the class period.

For the most part (90, % of the rural students), exhibited interest and commitment throughout the activities. The series of lessons were easy and functional as well.

Some of the most relevant comments teachers made during the interview are quoted below:

> "I prefer to liven up my lessons by using multimedia to better explain complex concepts that cannot be easily understood using text or voice alone."
>
> "Multimedia helped me and the rural schoolchildren improve our performance."
>
> "Multimedia learning materials become an alternative to ensure a meaningful, useful and relevant learning that tends to complement the traditional printed resources used in the classroom such as photocopies, sheets, notebooks, workshops, maps, board, drawings, and oral lectures."
>
> "Experiences like the present through multimedia promoted active learning acquisition as it favored interaction with curriculum contents during the lessons."
>
> "Both rural teachers (like me) and schoolchildren increased our curiosity towards the novelty of these tech gadgets."
>
> "Participants become motivated when working with one computer and develop the tasks at their own pace."
>
> "The experience was motivating, beneficial, inspiring and practical for rural students because they were able to incorporate their previous information as the basis for developing new digital skills and acquiring curricula contents."

In terms of curricula advantages and practicality, teachers expressed that rural schoolchildren seemed to develop the different activities effectively and creatively leading them to better learning outcomes as well as better classroom atmosphere. Yet, while most rural teachers find multimedia materials motivating and meaningful, others still saw the use of computers as challenging, overwhelming or time-consuming.

When dealing with digital tools, teachers insisted that computers are necessary for rural settings but may require some high-tech know-how for those who like to create their own instructional materials or renew technological applications. Several aspects in this regard drew attention during the process. Only 5 % of respondents considered that:

> "Using computers, of course, involve us in more work."
>
> "As computers are out of the reach of rural parents' possibilities, it is a serious limitation to plan innovative homework and permanent searching of updated information."
>
> "Nonetheless, the number of machines and the size of the room were not enough for the number of children."

Another underpinning call posed by teachers was: "It is imperative and urgent to impact the rural school curriculum and the educational community".

As it may be expected, rural schoolchildren rated their multimedia learning skills as successful, being 100 % the highest percentage. No rural student has ever reported any disadvantage other than the insufficient number of computers at school and homes. A significant suggestion has to do with including multimedia learning materials in their daily classes.

Discussion

In response to the research question, which asked about the process of creating and interacting with multimedia materials in rural schools, favorable impacts were confirmed within the context of a Colombian setting. It was established both the teachers' and students' perceptions regarding the implementation of multimedia in their classroom as it is an effective technological tool to raise and maintain students' motivation and interest during the lessons.

The results of this research project agree with previous research contributions such as those derived from the works by Galvis (1993); Herrera-Mosquera (2017); Lee, Hsiao and Ho (2014); and Mtebe, Mbwilo and Kissaka, (2016), which focused on processes and competencies of participation, creativity, interactivity, enjoyment, and emotional feelings that emerge when applying computer multimedia learning materials. This might be one of the reasons why the target population of the rural school, where the research project was carried out, became fully involved with the most common facilities that multimedia learning materials offered.

It is worth mentioning that the main value of this work was the creation of multimedia materials that identify the rural region and were inspired from the drawings made by the schoolchildren themselves, such as the buzzard, the duck, the cow, the flower, the rabbit, the pulping machine, the apple, the rabbit, the frog, the fungus, the jeep, and so on. In other words, the possible explanation of the expected findings could be the presence of original drawings taken from the students' notebooks which later on played the role of animated multimedia characters.

These findings correlate to other authors who claim that it is possible to adapt teaching to the specific needs and characteristics of educational contexts. In this line of action, Lee, Hsiao, and Ho (2014) recommend that, when designing animated characters, it is important to take into account the students' previous learning experiences, emotional reactions, interests, and curiosity, because these conditions ensure successful learning outcomes which are linked to creative and critical skills. That is why the outcomes of the present study go beyond the traditional conceptions overcoming the barriers of curriculum management.

It is also possible to determine how much teachers are enthusiastic and express satisfaction, which makes them believe that multimedia learning materials become a novel and essential alternative to do successful classes. Likewise, in Mtebe, Mbwilo and Kissaka's study (2016) "teachers perceived the use of the content would be pleasing and enjoyable" (p. 81). In the same vein, Galvis (1993) introduced surprising changes in the virtual school environments. Nonetheless, their use, applicability, and adjustment have generated diverse critical positions, debates, and controversies. One of the major problems is the difficulty to adapt teaching to the specific needs and characteristics of educational contexts. Herrera-Mosquera (2017) found out that, despite the many benefits when dealing with the relationship between people with the machines, there are numerous limitations, such as waste of time, no added value, many teachers do not implement modern technologies, unsolved technical problems, low quality of connectivity, lack of resources, and the like.

Although multimedia learning materials can bring to improve classroom practices, there are both advantages and disadvantages. Most of the rural teachers and schoolchildren interacted with these materials for the very first time, because they do not have computers at home, whether for financial or cultural reasons. Furthermore, they neither get fully engaged nor have equal chances to access the scarcely available tools at school. In a different vein, Liao et al. (2016) emphasize the importance of having computers in students'

homes. Saltsman (2018) insistently points out the need to qualify a big number of teachers in the proficient use of technology to meet the millennium goals: "investing in teachers is the key to achieving the Education 2030 goals" (p. 113).

Despite some valid controversies, limitations, and even, some technical disadvantages, these findings contribute to explain that digital technologies transform traditional educational practices. For this reason, it is necessary to reflect on this topic of the discussion focusing on the implications for policy development. Firstly, Governments and policymakers must take into account that there are new countless possibilities that substantially contribute to the idea of new rurality for the 21st century. Secondly, the national ministry policies and UNESCO (2014) emphasize that different institutions, groups, and experts have shown an interest in carrying out processes, tools and techniques, as well as micro and macro projects to support the incorporation of technologies for educational purposes, especially from developing countries which requires national or international cooperation: "Contemporary pedagogical strategies cannot be successful without using information and communication technologies" (Dolzhikova & Kholina, 2018, p. 11). Third, teachers and researchers are challenged to propose innovative solutions.

The design and use of interactive learning materials is a prime necessity to teachers and students, but, at the same time, it poses challenges to be faced by the education of the present and the future. Taking advantage of innovative materials available in developing countries, Mtebe et al. (2016) further state, implies "equipping teachers with the required skills to improve the quality of education" (p. 79). However, increasing computer availability in rural institutions is not the only solution that can reduce the digital divide of school children.

Another issue repeatedly discussed today has to do with the increasing amount of sophisticated digital devices. Indeed, electronic networks, video games, multimedia, virtual environments among others grow and expand opening up new possibilities to access knowledge. An array of learning materials abound, offering educational benefits to be implemented. Herrera-Mosquera (2017) refers to a similar point of view "As students and teachers have become more proficient in the use of new technologies, more and diverse opportunities have emerged for educators in terms of curriculum design and teaching strategies" (p. 482).

As Dolzhikova and Kholina (2018) put it: "The future belongs to the digital economy" (p. 11). Although the most modern technologies have been increasingly grown-up to the extent that more and more people have transformed the different historical, cultural, geographic and educational contexts, there are different convergent and divergent points of view. Another divide worth mentioning embraces the difficulty for some rural people to access new technologies. It means that, nowadays, accessing technological environments in the pedagogical processes is one of the most critical issues because they are not equally available to all rural settings.

The aforementioned issues have been drawn not only to remark the gap but to mitigate the persistent social inequality between rural and urban communities. In short, as the rural sector is the most deprived, it becomes a social commitment to the educational system. This claim aligns with the approaches of Munévar et al. (2024) because the different urban and rural regions of the Coffee Growing Eco-Region are protected by the regulations derived from national policies regarding citizen participation, social, economic and environmental rights. Likewise, Posada and Giraldo (2023) argue the constitutional basis that, since the 1991, Political Charter favor Colombian educational and community environments by recognizing their identity and exercising their functions in a social and democratic state of law.

Based on the results of the application of multimedia technologies derived from this research, a debate is left open on the social, cultural, political and economic impacts, not only for the territory delimited to coffee rural schools, but for other territories of the country. While the technological infrastructures are not sufficient for the development of all curricular areas, the school does have opportunities to fulfill its social mission protected by constitutional guarantees, by reorienting the contents that are taught in order to preserve and enhance ecosystem functions that contribute to territorial ordering. Within the natural and social sciences education, it is possible to generate critical awareness to address current challenges such as

environmental pollution problems that require political interventions through the use of citizen participatory rights in search of social justice. This aspect was implicit in the lessons designed with multimedia applications. These curriculum contents have overcome the step-by-step of instructional materials because they managed to stimulate the creativity both of the team that designed the lessons and the students who learned about regional aspects, as required by the legal frameworks for Colombian schools.

Conclusions

Bearing in mind the results of the present project, achievements, and impacts of multimedia learning materials in rural classrooms were shown to enhance teaching and learning strategies. It can be stated that integrating multimedia learning materials into rural classrooms indicate a potential and effective decision-making path to improve the students' learning according to their interests, rhythms, participation, and previous ideas from their rural context.

Students like to learn in front of a computer when they can access original and attractive lessons; which means when curriculum contents are presented with color, shape, games, videos, and animations. Participants confirm that combining music, movement, animals sound, and interaction promotes meaningful learning.

Rural teachers ratify that students learn best and their interest increases when interacting with multimedia materials, despite the limited computer resources available at rural schools and homes. For this reason, they are motivated to renew their teaching methodologies. It is possible to understand the relationship between digital tools and instructional environments. The teachers perceive that the experience is for the most part satisfactory. Rural students disclose positive attitudes, participation, and also increase levels of personal responsibility. It is through the experience with multimedia materials that each rural student is eager to share their tasks with others. Each one becomes more motivated and fully completes the tasks with all the proposed activities maximizing the learning opportunities.

Derived from this research study, the rural school curriculum can be impacted since multimedia strengthens the pedagogical processes and, besides, constitutes well-appreciated resources and tools supporting the improvement of learning and capturing students' attention. It can be stated that creating multimedia learning materials is a very important, innovative, and beneficial proposal because the educational rural community as a whole turn the views of their classrooms into a more proactive teaching and meaningful learning interaction. That is, the design, application, and use of interactive multimedia materials represent a curricular innovation, which can be expanded to other themes, levels and institutions. Similarly, it is recommended that teachers, researchers, methodologists, school staff and education authorities continue to delve into the great potential of technology shedding light on the field of curriculum innovations.

To adapt training processes according to the characteristics of rural settings, it is necessary to create new scenarios, instruments, and methods. Finally, there is much to be done in rural education settings, so that the action plans of the institutions, can also respond to a new phenomenon from their own contexts: The high-tech era.

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Notes

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