ALTERNATIVE TO TRAIN SPANISH SPEAKING MATH TEACHERS FOR TEACHING IN ENGLISH SPEAKING COUNTRIES

ALTERNATIVE TO TRAIN SPANISH SPEAKING MATH TEACHERS FOR TEACHING IN ENGLISH

AUTOR: Michel Enrique Gamboa Graus[1]

DIRECCIÓN PARA CORRESPONDENCIA: michelgamboagraus@gmail.com

Fecha de recepción: 24-06-2020

Fecha de aceptación: 18-08-2020

ABSTRACT

Teacher Training and Teacher Development for specific purposes is a priority in Foreign Language Pedagogy. Cuban Mathematics teachers have provided methodological counseling in English language, or assumed the teaching-learning of Mathematics in institutions of Africa and the Caribbean. These teachers should be able of adequately manage such internationalist and collaboration missions. However, there are limitations related to their pedagogical training to cope with the syllabus according to dissimilar contexts, because training programs have been focused on English language as the only subject of knowledge. This paper aims to introduce an alternative to train Cuban Spanish-speaking Mathematics teachers for potential collaboration in English-speaking countries, based on typical activities related to characteristics of the target countries and objectives of the kind of schools. In this regard, several shortcomings were highlighted and the contextualization was undertaken, based on the articulation of interactions according to the contextual reality. The essence of the proposed solution consisted in using several curriculum organizers for planning the teaching-learning process, with an integral pedagogical diagnostic as background, making use of the experiences of teachers who have been collaborating in English-speaking countries. In order to access the sources for data collection it was applied the experimental method, with a pre-experimental design because no control groups were available. The sample was a set of Math and Physics teachers trained at the University of Las Tunas, through postgraduate courses, to teach Mathematics in English language. The quality of their performance as Math teachers was enhanced, for potential collaboration in such countries.

KEYWORDS: Mathematics; teaching; contextualization.

[1] Licenciado en Educación, especialidades Matemática-Computación y Lenguas Extranjeras. Doctor en Ciencias Pedagógicas. Profesor Titular del Centro de Estudios Pedagógicos de la Universidad de Las Tunas, Cuba. ORCI ID: http://orcid.org/0000-0003-3704-9927

ALTERNATIVA PARA ENTRENAR PROFESORES DE MATEMÁTICAS DE HABLA HISPANA PARA LA ENSEÑANZA EN PAÍSES DE HABLA INGLESA

RESUMEN

La formación de profesores para fines específicos es una prioridad en la Pedagogía de Lenguas Extranjeras. Los profesores cubanos de Matemáticas han brindado asesoría metodológica en idioma inglés, o han asumido la enseñanza-aprendizaje de las Matemáticas en instituciones de África y el Caribe. Estos deben ser capaces de manejar adecuadamente tales misiones internacionalistas y de colaboración. Sin embargo, existen limitaciones relacionadas con su formación pedagógica para enfrentar el programa de estudios según contextos disímiles, porque los programas de formación se han centrado en el idioma inglés como única materia de conocimiento. Aquí se introduce una alternativa para capacitar a los profesores de matemáticas de habla hispana para una posible colaboración en los países de habla inglesa, basada en actividades típicas relacionadas con las características de los países y los objetivos del tipo de escuelas. Se destacaron varias deficiencias y se emprendió la contextualización, basada en la articulación de las interacciones según la realidad contextual. La esencia de la solución propuesta consistió en utilizar organizadores del currículo para planificar el proceso de enseñanza-aprendizaje, aprovechando las experiencias de profesores que colaboraron en países de habla inglesa. Se aplicó el método experimental, con un diseño preexperimental porque no se disponía de grupos de control. Las muestras fueron profesores de matemáticas y física capacitados en la Universidad de Las Tunas, mediante cursos de postgrado, para enseñar matemáticas en idioma inglés. Se verificó que mejoró la calidad de su desempeño como profesores de matemáticas, para una posible colaboración en esos países.

PALABRAS CLAVE
Matemática; enseñanza; contextualización.

INTRODUCTION

English language learning is a requirement for Cuban Mathematics teachers. Thus, it is necessary to assume the responsibilities that our economic, social and scientific technical development demands. They must provide services, both inside and outside Cuba, that meet the highest quality standards. The export of educational products and services are a priority in Cuba nowadays. In this perspective, several teachers have carried out the functions of methodological counseling, or have assumed the teaching-learning of several subjects, in heterogeneous institutions of different English-speaking countries in Africa and the Caribbean. As a consequence, the demand of Mathematics teachers for the fulfillment of internationalist and collaboration missions in different English-speaking countries is increasing.

The University of Las Tunas assumes the permanent training of the province teaching staff, through different postgraduate activities because only recently started to do it in undergraduate programs (Borrero & Gamboa, 2015), where the English language approach was through the implementation of a curricular strategy for comprehensive training (Gamboa y Velázquez, 2013). Likewise, through its Department of International Relations, it plans and controls the training of collaborators from different specialties of education to fulfill tasks outside the country. This is fostering high quality professionalism, as well as pedagogical preparation in different languages, including English.

Most of the English-speaking countries, where Cubans have collaboration agreements, have a curriculum design expressing the unity between centralization and decentralization. Therefore, every school has the curriculum design according to the characteristics of the context of teaching and learning. In such way they will have: A based curriculum (It is the content specified nationally, mandatory for all schools, which ensures the essential objectives of the graduates). A school curriculum (It is the content specified by each school [themselves], in correspondence with the characteristics of the educational process in each school, which is also mandatory for all students). An optional curriculum (It is the content that is chosen by each student [optional] from the school offers, which complements to their comprehensive education).

So, the curriculum is closely related to the experiences that are lived daily, what it is learned and how. We must also draw attention to the way in which such experiences are implemented and it is a must contextualize it. Hence, training Cuban teachers to work in this context should include alternatives to do it from a curricular design, development and evaluation, based on the solution of educational problems according to English speaking countries.

Also, according to my experience, most of those countries work with an open curriculum where the educational administrations define prescriptive minimum aspects that allow a concretion from the curricular design to different contexts, realities and necessities. Then they use three different levels. The macro level corresponds to the educational system in general, which involves the maximum level that carries out the curricular design. The meso level is materialized in the institution or intermediate instances; it takes into account the institutional context should be characterized to be concrete, feasible and evaluable. The micro level comprises the classroom-based activities; the individual learning experiences or units must be designed, as the teaching objectives, contents, development activities, evaluation activities and methodology of each area to be materialized in the classrooms.

Teachers are protagonists at the micro level of the curricular design. However, there are still noticeable discrepancies about it in training Cuban Spanish-speaking Mathematics teachers with potential to work in English speaking countries. The contradictory present scenario shows lessons based on what is going to be learnt, without previous reflection about who learns, how and under

what circumstances. They still do not understand the importance of curriculum and the role they play in it to enhance the quality of their job. A significant number of teachers consider that curriculum design is something to higher authorities, whose officials have an obligation to undertake such work.

Such is the perspective from which I start this paper, from the potential and shortcomings presented by Cuban Mathematics teachers, to address the curricular design at the micro level, according to the context of English-speaking countries. The context does not limit, but provides a wider vision for planning. Each one of the students is unique, special and different. They have dissimilar knowledge backgrounds, previous experiences, habits, skills, attitudes, norms and moral values as well as different interests, motives, expectations, dreams and hopes.

A good education is not only one from head to head, but also from heart to heart. However, the teacher´s efforts remain only until the dosage of content to offer and lesson planning. A more comprehensive vision of curriculum is lost. I have been able to verify some manifestations of inadequacies in the teachers selected to receive training to teach Mathematics in English-speaking countries, such as: The selection and organization of the mathematical content does not prioritize culture, educational policy, precedence and main educational problems of English-speaking countries. The application of the mathematical content to situations given in the objective reality of the English-speaking countries context is limited. The teaching resources are not planned in an efficient and effective way in function of the current technological development of different English-speaking countries. It is lacking communication, interaction and analysis on the solutions of professional problems according the context reality of English-speaking countries.

These shortcomings reveal the contradiction between the need to train teachers capable of adequately managing the teaching-learning process of Mathematics in English-speaking countries, and the aforementioned limitations in relation to their pedagogical training to contextualize the curriculum design, based on typical activities in correspondence with possible contexts of action, for potential collaboration in English-speaking countries. This scenario favors the emergence and intensification of difficulties.

The subject of the pedagogical training of teachers to provide collaboration in English-speaking countries has been explored by different authors. I go along with Waller & Flood (2016), as they display that Mathematics is composed of definitions, theorems, axioms, postulates, numbers and concepts that can all generally be expressed as symbols and that have been proven to be true across many nations. Through the symbolic representation of mathematical ideas, communication may occur that stands to break cultural barriers and unite all people using one common language.

Dubinina, Stepanyan & Ganina (2018) give insight into the trilateral activity of the instructors in Higher Mathematics, English as a Foreign Language, and

Russian, as the language of the host country, aimed at providing entrant international students with a preparatory course of Higher Mathematics. They infer that close cooperation between the instructors in mathematics, English and Russian, contributes to students' progress. I aim toward an alternative where the instructors have expertise in the three fields. This way interdisciplinary interaction is enhanced, and the participants receive both professional development and improvement of their foreign language skills, together with fruitful experiences of the teachers in the target countries.

Barwell (2018) affirms that "research on the learning and teaching of mathematics in multilingual classrooms has deployed the notion of language as a resource" (p.155), and proposes a theoretical framework, based on sources of meaning, drawing on Bakhtinian theory and the contemporary sociolinguistics of multilingualism. Wilkinson (2019) offer a framework for language education researchers and mathematics education researchers to share insights, questions, and understandings from their complementary perspectives on the relationship between language and mathematics. He provides a set of perspectives with corresponding analyses; that, taken together, constitute a context for an interdisciplinary sphere of developing research and theory regarding language, literacy and mathematics learning. From my point of view this is an interesting perspective to be taken into consideration in training Spanish-speaking teachers.

Hansen- Thomas & Bright (2019) present the process of teaching and learning mathematics with emergent bilinguals as a multifaceted construct with unique challenges and opportunities. They stated that "deepening mathematical conceptual understandings can be a potentially challenging task for students acquiring English at the same time they are learning new content" (p.265). This is a reason why I agree to consider a range of pedagogical and practical issues when planning and implementing instruction. At the same time, I have the same opinion that the language of mathematics itself involves particular challenges due to its complex discursive structure, content- specific terminology and expressions, and symbolic language. That´s why "Mathematics teachers of emergent bilinguals must also have awareness of the nature of the language used in mathematics" (Hansen- Thomas & Bright, 2019, p.265).

Voskoglou (2019) illustrates the importance of the communities of practice for teaching and learning mathematics. Suh (2020) also deals with the preparation of teachers for linguistically-diverse classrooms, and provides suggestions for teacher educators whose target audience is prospective mathematics teachers, in order to contribute to the discussion of supporting English language learners in mathematics classrooms.

The way I see it, training Spanish-speaking Math teachers for teaching in English-speaking countries should have multiple opportunities to explore pedagogical issues and established practices in the target countries. For example, my experiences as a teacher in Cuba, Mexico, India and The Bahamas

contrast. Formation of numbers varies from culture to culture, the word "natural", referring numbers, means different in Spanish (it includes zero) and English (it excludes zero; with the inclusion of the number zero we have the set of whole numbers), and this is essential for teachers because the behavior of zero is one of the more troublesome parts of the study of real numbers. Besides, the use of decimal point and comma vary from culture to culture (1,000 is only one in Cuba, but one thousand in The Bahamas). At the same time, there are different measurement systems, and mathematical terms do not always translate well. A billion is different in Spanish (it means a million of millions: 10^{12}) and English (it means a thousand of millions: 10^{9}), and so on. I also train Spanish-speaking teachers of Physics and Chemistry, at the University of Las Tunas, for teaching in English-speaking countries, and the scenario is alike.

From my point of view, Cuban Spanish-speaking Math teachers are currently learning Mathematics, Pedagogy, culture and language in English, for teaching in English-speaking countries, but little research has been conducted in this area. However, it has not been analyzed from the point of view of typical activities corresponding to possible contexts of action (Sabonete, Gamboa & Mestre, 2016), some of them multicultural (López & Victoria, 2015), where the interactions of experiences with teachers who have been collaborating in English-speaking countries take place (Vázquez & Gamboa, 2013, 2014).

At the same time, the scientific literature refers to different types of integrated approaches to work in this level, such as decrolyans centers of interest (Decroly, 1939) or the project method (Kilpatrick, 1918). It refers to other different proposals, but also considers more realistic to start exercising in the design of teaching units (Torres, 1994). The main idea that I defend is that if Cuban Mathematics teachers use an alternative to contextualize the curriculum design of teaching units based on typical activities according to possible contexts of action, then they will enhance their quality levels of performance for potential collaboration in English-speaking countries.

DEVELOPMENT

Some antecedents related to Spanish-speaking math teachers training to work in English-speaking countries

The purpose of this section is to offer some historical considerations about the pedagogical training of Cuban Mathematics teachers to contextualize the curriculum in order to work in English-speaking countries. This allows the identification of needs and, consequently, to know the direction in which the training of future collaborators should be focused, as well as to assess the theoretical foundations that explain their development in correspondence with the possible contexts of action.

The historical study of this research began in 1991. From that year on, educational collaboration agreements were signed with English speaking countries in Africa, Latin America and the Caribbean fundamentally. These have been for the purpose of exporting educational services.

Training Cuban teachers for potential collaboration acquired greater relevance. Since then, it has become necessary to increase their pedagogical preparation. In this view, it has been sought to consolidate the results achieved so that the services destined to the exports reach the highest international standards of quality, as demanded by the updating of the Cuban economic model.

This historical study contributed to identify and understand the causes of current inadequacies in training Cuban Mathematics teachers for potential collaboration in English-speaking countries. The data described lead to a deeper understanding of the current state of the research question, its causes and future evolution, in accordance with the possible contexts of action. This allowed me to justify the need for changes to solution and the social significance of the result that is aimed to achieve.

The provision of educational services began to make an important contribution to the country's economic recovery. These agreements in the educational sector include English-speaking countries; Botswana, South Africa, Jamaica, Bahamas, Grenada, and others.

Training Cuban Spanish-speaking Math teachers in English, in the beginning, was performed spontaneously in the Language Schools and basically intended for Higher Education teachers. This was done through basic English courses, with the aim of training new teachers for changing the academic ranks. This is according to my own experience and testimonies from R. Arrowsmith, collaborator in the Republic of Botswana (1992-1994) and Bahamas (2007-2010), J.R. Riverón, collaborator in the Republic of South Africa (2002-2005) and A. Cruz, collaborator in the Republic of South Africa (2002-2005). Subsequently, different English courses were offered for specific purposes with the aim of increasing communicative competence in this language.

In order to train the future collaborators, the Regional Preparatory Faculties (East, Center and West) were created. Thus, in 1995, emerged "Frank País" Language Preparatory Faculty at the Higher Pedagogical Institute of Santiago de Cuba for teachers of Mathematics, Physics, Chemistry, Biology, Physical Education, Technical Education and Special Education of the five eastern provinces. Work was done during a full-time course.

The regional courses in these Faculties were taught on the basis of programs with specific objectives and contents. They were well structured and organized, and awarded diploma papers to the graduates. Emphasis was placed on the development of basic skills (writing, grammar, listening and speaking). However, in these faculties, training was centered on a single matter of knowledge, the English language.

The participation of mathematical tutors was limited according to the criteria of Cisneros (2006). The diagnostic and development of the communicative skills of the teachers determined whether or not they remained in the training and finally their presentation in the interview with the foreign party (Hickling-Hudson, Corona & Preston, 2012).

A specific purpose English course started at "Pepito Tey" University of Pedagogical Sciences, in 2010-2011 academic year. This was intended one-year full time for teachers from different specialties of Las Tunas province. In addition, a part-time course of deepening and systematization of English for specific purposes began since the academic year 2011-2012. Both courses continue to be offered today. With regard to language teaching, the Communicative Approach (CA) was maintained, but there was an in-depth exchange of experiences with teachers who have collaborated in English-speaking countries. However, this has not been enough to achieve the adequate training of teachers to contextualize the curriculum.

As a result of this study I established the following regularities: The training of Cuban Mathematics teachers for potential collaboration in English-speaking countries has responded to economic, political and social context. It began centrally in the early 1990s in the Preparatory Faculties of regional languages and was decentralized to train teachers of different specialties in all Cuban Universities of Pedagogical Sciences. It has focused on a single subject of knowledge, the English language. It has not been sufficiently contextualized according to the realities of the countries and the subject curriculum. At present, it demands a more contextual and professional approach, so as to reach the highest international standards.

Theoretical, practical and methodological perspectives

Addine (2000) presents curriculum as the realization of the design, development and evaluation of an educational project which responds to certain bases and didactic conception. It is possible to distinguish, curriculum design, development and evaluation, as its three fundamental dimensions. So, curriculum design can be understood as a dimension of the curriculum that reveals the methodology, actions and the result of analysis, modeling, structuring and organization of curricular projects. It is methodology in the sense that its content is about designing the curriculum conception. It is action because it constitutes a process of preparation, and it is result because this process leads to curriculum documents, and how to implement it and evaluate it. Then we use the three different levels to design it according to different contexts, realities and necessities. The levels are macro, meso and micro.

A significant number of researches, Canceló (1994), Garrido & Arnáiz (1999), Ballesteros (2002), and others consider that curriculum design at the micro level should be organized in a sequence of teaching units, responsibility of each teacher. I assume this approach and I add that it should be in accordance with the characteristics of student's needs. In Cuba, this idea is further justified by Zilberstein & Silvestre (2000), among others.

An accurate point of view concerning the teaching unit is introduced by Escamilla (1992). He presents it as a way of planning the teaching-learning process about a content item, which becomes integrating axis of the process, bringing consistency and significance. Rico (1998) and others, group the

methods, teaching aids and forms of organization into a single component called methodology to facilitate the structuring of the teaching unit and its dynamics. In such way, together with the objectives, content and evaluation of each unit, they present the four components of the curriculum that characterize it as scheme of work for teachers.

This generates a new dialectical relationship, due to the internal relation among the objective and the content with the method, which is a law that determines the dynamics of the teaching-learning process. The objective expresses the need and it functions as synthesis. The content refers to the possibility as analysis of its elements. The methodology represents the reality as its structure to carry it out according to the social needs. This is an expression, in short, of the dynamic need-possibility- reality that is presented on the philosophical level.

It is a need to organize the realization of micro-level curriculum. A design according to objectives, contents, methodology and evaluation is an excellent way. However, it should be characterized by a contextualized methodology. Those involved in the teaching-learning process need to be congruent with the Vygotskian approach to curriculum in contemporary pedagogy (Gamboa, Carmenates & Amat, 2010; Gamboa & Carmenates, 2011; Gamboa, 2012; Joaquim, Gamboa & Fonseca, 2017; Gamboa, 2019). In this sense, in previous models, the objectives and the contents are increasingly contextualized. However, in contrast, the methodology and evaluation prove to be out of context. This indicates a contradiction that affects the process of education for life and the essential contribution of science to everyday life.

Fundamental ideas of curriculum design at the micro level

Teachers must think and structure transformative activities based on the obtained of living reality, and not on generalizations of other moments and contexts. A crucial point of the Marxist theory of knowledge is that it places the productive activity of men at the base of the process of knowledge (Afanasiev, 1981). Circumstances make man as much as he makes the circumstances (Marx & Engels, 1973). These are not an insurmountable obstacle, their modification is possible, but while he transforms them, he is also transformed. We can modify the circumstances of our teaching-learning process in a way that produces better experiences and a better influence on the students.

Human thought has a character qualitatively superior to any mental activity of the rest of the animals. So, we can stand up above the restrictions of the present and to plan, to predict and to intervene according to a conscious plan, taking into account the real characteristics of our students.

We have to educate in a particular context that is subjected to a constant process of change, movement and development. The detection, explanation, prediction and solution of the problems that are presented should be analyzed starting from the knowledge we have about this changing reality. Something is born, starting from changes that seem to be insignificant, which in turn provoke new changes. The sudden change that modifies the nature of the class

takes place. Each one of the changes in the teaching-learning process is of vital importance and therefore, they should be conceived with much care.

The cause-effect process in teaching and learning allows us to carry out important predictions in our classroom programs, but chance also plays its part. We should avoid repeating successful situations or failures without analyzing the facts.

There are several reasons why scripted curriculum in a box does not work: Because what works in one classroom often will not work the next period, flexibility, intuition, and judgment calls by instructors are needed. Values and motivations vary among classroom. Pre-packaged curriculum undermines teachers' professionalism and agency. Cultural sensitivity does not come in a package. All students are not at the same level of development. Scripted lessons interfere with the teacher-student relationship.

We should stimulate interests and motivation to satisfy the needs of our students to live and to grow in the integral order. The process of education is about preparing the students for their lives. We must equip their bodies, minds and souls for the beauty of life. As teachers, we can create this kind of motivation by linking rigorous academic content to students' personal lives and the community issues they care about. One of the most powerful strategies teachers can use to make learning relevant is to place academics within the context of issues and problems from the world of work.

The atmosphere of learning is not confined to an isolated individual. Education is conceived as an interaction between the school and the life of those involved. There is satisfaction in the process of knowing and sharing this learning with others. Students' learning can be lasting if the process is pleasant, if they find joy in it. We need to provide an appropriate interactive climate of research, reflection and states of well-being in the teaching-learning process of Mathematics. We should promote an atmosphere of reciprocity, trust and respect while we are teaching, because we need to be perceptive to the gradual advances of the students. We have to help them to be confident to produce valuable knowledge. They can and they should do it.

Teaching units as alternative to curriculum design at the micro level

The organization of education in teaching units is not a simple and immediate process that ensures a desired product. Teachers have to overcome multiple difficulties to approach the design of a teaching unit, due to the complexity that characterizes the proper exercise of teaching: this activity is multi-dimensional; teachers have a curriculum framework, working conditions, training experience, innovation, reflection, creativity, content domain, among others.

Ballesteros (2006) refers to some of these difficulties: time available, lack of motivation and insufficient conviction of the effectiveness of education programming, need for a thorough knowledge of content for teaching, training deficiencies in the educational level, little experience in this type of practice,

inability to adapt to the conditions and possibilities of natural and social environment of the medium in which students perform, ignorance about the features and capabilities of students, influence of preconceptions and received teaching experiences, low production of new resources and materials.

There are significant difficulties to be overcome in order to take the alternative of teaching units as a planning instrument. However, there are many advantages about it. This way eliminates the excessive reliance on chance. It helps to eliminate incomplete programs and processes involving reflection on a project area. It promotes better use of time. It generates feeling of control over processes, confidence in what is proposed, and trust in the proposal. It guides interactive teaching and learning processes that are implemented to adapt the work of each teacher to the characteristics of the class. It produces professional growth when making conscious choices, proceeding through self-reflection and reviewing what happens in the classroom.

Designing a unit involves planning and developing. It involves making choices about what, when, where and how to teach. A key principle of unit design is how to ensure that learning outcomes, learning experiences and assessment are aligned. Incoherent curriculum produces jumps, repeats, mixes ideas.

Torres (1994) suggests that all curriculum project can be organized in multiple and diverse ways, but in each one of them is needed a preceding reflection about the reasons and consequences of the solutions to be decided. He also offers suggestions to facilitate the development of teaching units with an integrated nature. However, among the elements outlined to design them, the pedagogical diagnostic does not cover important contexts of action as the family. It is seen as a stage prior to selection of the topic to investigate and therefore it is not considered a dialectical relationship expressed in the historical-cultural approach, which affects contextualizing the teaching units.

Rico (1998), in Mathematics, proclaims that there are objective and useful sources of knowledge for proper programming of teaching units. He refers to curriculum organizer as knowledge which is adopted as fundamental components to articulate the design, development and evaluation of teaching units. This allows teachers to discuss and reflect on how they are planning to sequence the content, design activities and prepare the evaluation in Mathematics classroom programming. It influences decisively on the different components of the curriculum.

There are other proposals for curriculum design in micro level based on teaching units such as Ballesteros (2002), De Pro (1999), Makovec & Radovan (2015), among others. Some of them present a sequence of interdependent tasks for a detailed design, meanwhile others say that the specific way of designing a specific teaching unit does not have to obey an only model or format. They refer target selection, content analysis, the initial diagnostic, the selection of teaching strategies and the selection of evaluation strategies as components of the teaching unit. They focus on the contextualization of the

process but they lose the perspective of the dynamics in the constant changes that occur and therefore the methodology is gradually decontextualized.

There are examples in which there are teaching elements such as objectives, content, teaching media, media relations, organization, evaluation, personal components (teachers and students), context, experiences, methodological strategies, activities, guidance, coordination, feedback, pro-action, research, students' ideas, their motivation, the key ideas, problems, space and time situations. However, the contextualization of the methodology is treated superfluously, even when defending the contextualization of the content.

Gamboa (2007) evaluates different views on designing teaching units in Mathematics. There I presented the suggestions they offer, their strengths and limitations to meet the requirement of contextualization of teaching and learning from proper curriculum design. As regularity, in the analyzed models, the teaching units are presented as a previous organization of the teaching-learning process. It is explicit that its design is a way of understanding what teachers think to offer directly to students. This allows articulating them on pre-established solid foundations and from a content item increasingly contextualized as an integrating axis.

However, the methodology presented in these models is aimed to plan the corresponding sequence of classroom activities, the role that the teacher will play and the type of tasks that students will perform individually or in groups, time and the space in which they are going to be carried out, the resources that will be useful, among other things. So, interactions that occur in the process of teaching and learning of Mathematics are unattended. It is required a contextualized methodology for handling increasingly contextualized content. This indicates a contradiction between these two components that affect the process of education for life and the essential contribution of Mathematics to everyday life.

The design of teaching units according to the context leads to solve the above contradiction, although the theory does not fully explain how. In addition, to address this situation, teachers in charge of the teaching-learning process of Mathematics do not have adequate theoretical training, or feel sufficiently prepared. However, they recognize the need for their involvement in the design of the curriculum to contextualize the learning process. That is why I introduce the following model of the curriculum design of contextualized teaching units.

Characterization of current state of Cuban Spanish-speaking Math teachers training to work in English-speaking countries at University of Las Tunas

In order to identify the causes of the shortcomings related to the educational training of Cuban Mathematics teachers to work in English-speaking countries, a sample of 30 math teachers was selected from Las Tunas province. A questionnaire was used in order to obtain general information on teachers for initial characterization of the sample. It was designed taking into account

application forms that future employees must complete before reporting to an interview with the foreign party.

The preliminary characterization of the sample indicated that: The University of Las Tunas has conditions, infrastructure and technical resources to provide training to Mathematics teachers to work in English-speaking countries. Some of the faculty staff collaborated as Mathematics teachers in English-speaking countries of Africa and the Caribbean. There is significant professional and academic experience of Mathematics teachers from Las Tunas province in order to provide them pedagogical training to work in English-speaking countries. Mathematics teachers have motivation to learn how to work in English-speaking countries.

The current state of teaching coherence of Mathematics in the process of training Cuban teachers to work in English-speaking countries was evaluated implementing a statistical procedure (Gamboa, 2020b), which meets the basic requirements of reliability and validity. The variable measured was the teaching coherence of the teaching-learning process of Mathematics. It was interpreted in the dialectical interrelation between its components and indicators. The sources of information were the present students, teachers, employers of ex-students, curriculum coordinators, products of students and teachers and administrators. The aspects on which information were collected covered a wide-ranging set. The curriculum was evaluated in its design, development and evaluation. It was evaluated the organization and implementation of the school activities, the effectiveness regarding the learning, the teacher's and students´ performance. Also, it was evaluated the selection and use of teaching materials, the handling of time, methods, procedures and adopted ways of organization, among other aspects.

It was evaluated if the curriculum aims to reach the sustainable development of the country and the region. According to that, the teaching-learning process of Mathematics should strive for the achievement of a wide projection toward the territory, the region and the country. It has to be effectively inserted in the main development programs and prioritized investigation projects.

The instruments required for data collection were achievement tests, questionnaires containing fixed response, restricted response and open-ended questions, as well as interview and observation schedules. It was done by conducting personal interviews and making on site visits for observation in unobtrusive manner. Triangulation was also used in a combination of data collection strategies. Sources, methods, theories, resources, information were contrasted to give greater reliability and validity of research. The information that was collected during the postgraduate courses allowed evaluating the teaching coherence with an average category. Some reasons for this evaluation are shown in this section of the article.

The teaching structure of the components had not a system approach in correspondence with the characteristics of the country and the objectives of the

kind of school. Curricular dynamics and the training process were not characterized by the use of updated teaching methods, organization ways, teaching aids and pertinent assessment systems that favor the students' proactive participation in their own training. The research activity of the students was developed with a low level of quality, being uncertain the development of professional performance.

At the same time, assessment was not linked to the main problems of the countries and the objectives of the kind of schools. The students did not stand out for being protagonists and proactive subjects of their training process. They did not have the general and basic arrangement to assimilate the studies.

The teaching learning process did not have enough and pertinent materials, with the necessary varied, updated and upgraded bibliography. They did not have high quality didactic materials elaborated by the teachers and students, facilities, equipment and inputs required for the educational and investigative activities. The material support did not promote the fulfillment, with quality, of the demands of the training process. They did not have an integrated system of teaching aids that guarantees the access to students´ learning. The services of Intranet and Internet were not used for the students in correspondence with their training needs.

The academic results confirmed the low quality in the formative process. Students showed limitations in the development of pedagogical training. This implied that the sampled teachers needed high levels of support so that in the long term they could be able to contextualize the Mathematics curriculum in order to work in English-speaking countries. Only two teachers showed an adequate level of development that allowed them, in the short term, to be in a position to do it.

The fundamental cause, revealed with the study, was that training programs are intended for teachers of different specialties and these have not been adequate enough to the particularities of Mathematics teachers. So, there are insufficient teaching guidelines to design the Mathematics curriculum with a developmental approach. The main way used for teaching is the study of content from the books, the orientation of exercises from folder sheets and a review of content with difficulty. This neglects the motivation necessary for its study, and the communication between the students. At the same time, training Cuban Mathematics teachers to work in English-speaking countries has focused on a single subject of knowledge, the English language. Only isolated actions are carried out, in order to raise pedagogical knowledge, disciplinary knowledge and disciplinary pedagogical knowledge.

These reasons led to elaborate an alternative to contextualize the curriculum design of teaching units for Cuban Mathematics teachers. It allows integrating the development of pedagogical training for educational communication in accordance with the requirements of collaboration in English-speaking

countries in Africa and the Caribbean, making use of the experiences of teachers who have been collaborating in English-speaking countries.

Contextualized teaching units as the proposal to enhance the Cuban Math teachers' performance for collaboration in English-speaking countries

The design of the teaching-learning process of Mathematics based on contextualized teaching units is a way of planning such process as a system around curriculum organizers, consistent with the learning context, to dynamically articulate interactions according to the contextual reality. Then, a qualitative leap occurs and manifests teaching coherence as a new quality at the micro level of curriculum design of Mathematics.

The design of teaching units is on the third level of curriculum design. Therefore, it should not be seen as a separate process but rather as a link in the chain of curriculum. There must be a coherent articulation at the micro level itself, but also with the meso and macro levels.

At this stage the teacher must locate and process the necessary information for the didactic treatment of the unit, from the macro level of curriculum to everyday classroom activity. Teachers must seek guidance on many aspects: treatment to the systematization of knowledge; trilogy concepts-relationships-procedures; different typical situations of teaching Mathematics, as the formation of concepts and definitions, theorems and their demonstrations, exercises and solving problems, developing procedures, algorithmic and heuristic solutions, solving exercises on geometric building, demonstrations, among others.

However, this study is not enough to undertake the design of teaching units as a process of adaptation to the context. Some teacher may be tempted to save time and immediately begin writing their lesson plans, but that will cost them more time and limit the effectiveness of curriculum. So, I establish a contextualization process to run according to those who receive such proposals.

This model is focused on those involved in the process and not only to the adequacy of the content. The primary relationship that streamlines this process is between the pedagogical diagnostic and the curriculum organizers. It guides the contextualization of the methodology and gives dynamism to the system, as an expression of a different way to achieve the necessary coherence in the curriculum.

The integral pedagogical diagnostic must be established with several features. This should be dynamic. It must be experiential, integration between the university and society, as an expression of the link between study and work serves the integral formation of students by solving problems in different work, production and service entities, so it is necessary to intervene in each of the training scenarios with a questioning look to know what happens to the person in them. It should also be holistic.

This diagnostic should also be done with empathy, and should provide the possibility that the students consciously intervene in their own diagnostic (self-evaluation) and expose their needs and potential. Also, it must be teleological, and to do that it is established five key diagnostic contexts in which teachers must be involved: student, school group, managers, family and community.

We must articulate a curriculum related to the demands of society in general, starting from the personal aspects. It is conceived a university to prepare the individual for life beginning from their own lives. With this model a process of social collaboration is established in the design of the curriculum at the micro level.

It is been taken as reference the approaches of Rico (1998), Gamboa (2007), Gamboa & Fonseca (2014), Gamboa & Borrero (2016), Fonseca & Gamboa (2017), Gamboa & Borrero (2017), for the work with the organizers of the curriculum in the design of contextualized teaching units. This improves with the potentialities usually detected in the learning process and the axiology in the implied contents. Also, essential new relationships are revealed, as the necessity that this it has as background an integral pedagogic diagnostic that contributes to the consistency for their optimization and success.

The following organizers are settled down:

- Errors and potentialities usually detected in learning Mathematics

The teacher, when designing Mathematics curriculum, should not focus exclusively on eliminating shortcomings that occur in students, but also it should provide an appropriate educational treatment to well acquired content. We should know what treatment to follow with them (Gamboa & Fonseca, 2017; Silva, Gamboa & Domínguez, 2019; Gamboa, 2020a). Example: some students make the mistake of asserting that 0.456> 0.57 because 456> 57. This difficulty would not come to light if it were proposed to compare 0.4 and 0.56.

- The diversity of conceptual representations used for each system of concepts

This organizer allows the study of various aspects and properties of the same concept. It also enables research and increases training in the specific content being studied (Gamboa, 2013; Gamboa & Santiesteban, 2018; Castillo & Gamboa, 2016; Parra, Gamboa, López y Borrero, 2017). Example: when speaking of numeric domains, rational numbers (Q) represent fractional numbers and their opposites; also they are decimals whose development is finite or recurring infinite; besides they refer to the ratio of two integers where the denominator is different from zero; at the same time, they refer to the ratio of an integer and a positive natural number, among other representations.

- The phenomenology of the concepts and practical applications of content

Mathematics should be considered in connection with different events. Opportunities for experiencing Mathematics in contexts should be included

(Castillo & Gamboa, 2020a, b). We should promote working on problems arising in non-mathematical contexts. We need to enhance learning by imparting in our learner's skills that they need to function in this world. The lessons we deliver should be guided by the student´s everyday experiences. It is important that students understand why they study about it, in which situations they will be able to use it and how useful are the concepts learned. Example: to teach the Pythagorean Theorem teachers may consider measuring distances which cannot be accessed directly, optimization problems as laminating a cylindrical bar, among others.

- The diversity of materials and resources in teaching a topic

Finding different materials is claimed to improve math and communication activities as well as trigger thought processes and develop habits, skills and beliefs (Zaldivar, Cruz & Gamboa, 2015; Fernández & Gamboa, 2016; Fernández, Gamboa, Rodríguez & Alfonso, 2016; Santos, Gamboa & Silva, 2017; Cruz & Gamboa, 2020). The teacher should reflect, considering the overall pedagogical diagnostic, the most suitable to work at all times during the unit. At the same time teachers should involve the students in the preparation of teaching-learning aids to be used in class. It is needed a didactic update of resources to upgrade contemporary lessons according to the current technological development.

Teachers have to be engaged, motivated and updated. We should promote interactive learning with technology so as to help students strengthen problem solving and critical thinking skills. It also enhances learning opportunities for students and teachers selecting or creating mathematical tasks that take into account the advantages, such as graphing, visualizing and calculating.

- Cultural, historical and scientific evolution of each field and concept

The teacher should promote a vision of Mathematics in continuous progress, encouraging numerous and varied experiences about it. This organizer is used to understand the historical context that frames the concepts as well as to address the situation as it was considered originally. The intention is that students learn to value the subject, and its impact on their culture and their lives.

- Axiology in the content involved

Efforts are directed also to mobilize students from their feelings, emotions, needs, motives, interests (Carmenates, Rodríguez & Gamboa, 2014). This allows teachers to deal with quality educational proposals. It should be considered affective processes. The teacher should organize the teaching-learning process taking into account the participants. We change people's life; we better be careful and responsible with the way we do it. Example: It is well known the solidarity among the members of the Pythagoreans, who were famous for their mutual friendship, altruism and honesty.

These curriculum organizers are interconnected and guided by integral pedagogical diagnostic, in constant feedback determined by the diagnostic contexts. This is revealed as the main dynamic element of the model structure. It guides the contextualization of the teaching-learning process and the teaching coherence. The teacher can consider the customs and traditions of learners; this could also strengthen the identity of them. At the same time, teachers in specialized institutions can program a process more linked to music, dancing, sports, professions, among other viewpoints. In such way it is determined what to introduce in the teaching-learning process of Mathematics, why, where, how and when to do it and evaluate it, with a system approach. This contributes to develop the teaching competence of teachers.

The objectives are established as integration of instruction, education and development. Meanwhile, the contents are considered conceptual, procedural and attitudinal. This is done in transit through two main processes: selection and organization, according to organizers of the curriculum, based on the results of the comprehensive pedagogical diagnostic. With respect to methodology, it is done taking into consideration that situations and processes designed must enhance the development of learners. The reflection on the teaching unit should also lead to investigate the context evaluation from the contextual reality.

Let us be creative and give the learners confidence to do better. We should bring joy to them and encourage more learning. Teachers are to seek an evaluation of the students´ potential, properly contextualized according to their levels of development. Interactions to be designed are based on the evaluation, and the choices the teachers make will be as good as this is.

With the process done so far teachers can design systems of lessons more productive and have a greater impact. This model enhances rationality in decision making, provides new elements of analysis and prepares teachers to address their work. It gives more meaning to what is taught, how it is done and why. These are vital issues to achieve their integral development.

Evaluation of the effectiveness of contextualized teaching units in training Cuban Math teachers for collaboration in English-speaking countries

This didactic alternative for contextualizing Mathematics curriculum was applied at the University of Las Tunas according to the criteria of Gamboa (2018b, 2020b) and Gamboa & Borrero (2020). This is how the design of teaching units was implemented, based on typical activities in correspondence with possible contexts of action, for potential collaboration in English-speaking countries. The application of methods, the design of actions and the decision making to implement the alternative successfully developed fundamentally through the following moments:

- The diagnostic of the pedagogical professional competence of Math and Physics teachers from Las Tunas to teach in English-speaking countries (Vázquez & Gamboa, 2013). The design of the postgraduate course: “Teaching

Mathematics and Physics in English language" (Vázquez & Gamboa, 2014). This course was developed twice in different years in a blended manner, in the part-time mode. The selection of teachers. Teachers of Mathematics or Physics were selected because in different educational contexts of the English-speaking countries, they could teach both subjects. They had a degree or diploma in Education, or in any related specialties. They had a minimum of three years of experience in teaching Mathematics or Physics at any of the educational levels. In addition, they had a good proficiency in spoken, written and comprehension of English which was the medium of instruction. The design of actions to face the resistance to change the way of teaching. All activities were planned and developed in English. Conferences, seminars and practical lessons were presented. Different educational situations were presented, so that the possible solutions were discussed in groups or teams. The design of teaching activities by each of the teachers.

The variable measured was the performance of the teachers participating in the course. To measure this qualitative variable an ordinal scale was used. The categories used, in a graduation from excellence to lower levels, were: Outstanding (5), Above average (4), Average (3), Below average (2) and Poor (1). The scale applied by the Ministry of Education of the Commonwealth of The Bahamas for the evaluation of the performance of its teachers was used (Gamboa, 2018a). This was carried out taking into account that it is consistent with the objectives of the program. Such scale contributes to future collaborators becoming familiar with this form of evaluation that is similar to those used in different English-speaking countries.

In order to access the sources for data collection the experimental method was applied, with a pre-experimental design because no control groups were available. They were compared before, during and after implementation. Analysis and synthesis, as well as induction and deduction, were used as procedures for different methods, techniques and instruments. These were applied personally by specialists of the research project, making visits in unobtrusive manner, with a dialectical materialist approach. These included the questionnaire, the observation, formal and informal meetings, completion of sentences and study of the products of the pedagogical process. Using a greater number of them helped to get closer to reality and allowed the necessary triangulation that prevents mistakes. In addition, it was sought to comply with the statistical principle of not studying isolated events, as well as collect data as many as possible and occurred at different times.

Likewise, each indicator was measured from different perspectives, which allowed contrasting the results. Thus, the subjective perception of the participants in the courses was measured, together with the real state perceived by the applicators of the methods, techniques and instruments used. This was done to measure the initial state, in addition to several intermediate moments until the final state at the end of the courses.

The evaluation was made on the basis of the results in the activities developed by the participants, some of them were: the preparation of teaching materials, the design of electronic presentations for teaching, the design of experimental activities, projects and course work for the students, planning study guides, worksheets, instruments for the evaluation and qualification of the students, the design of books and spreadsheets in Excel for the control of attendance and evaluation of the students, planning and teaching of lessons, among others. It was strengthened that the participants in the course were able to self-evaluate and offer assessments on the evaluation of their peers. This was systematized in the different activities developed.

At the end of the activities, each of the indicators was evaluated and the respective scale was applied to each one of the participants. Then the group average was obtained in each of the 5 moments evaluated during the courses (Initial state, three intermediate moments and final state). The average never turned out to be a whole number, so the rounding procedure was used to grant the corresponding category. In correspondence with the above, the Table 1 shows the measurement from the initial state, evaluated as poor, until the final state, evaluated as above average.

Table 1: Measurement of group performance from the initial to final state

	Group average	Rounding	Category
Initial state	1,43	1	Poor
Intermediate 1	2,32	2	Below average
Intermediate 2	2,98	3	Average
Intermediate 3	3,07	3	Average
Final state	3,59	4	Above average

Likewise, Figure 1 shows the movement of this measurement with the trend line of the implementation of the proposed solution to the unfavorable initial state. The improvement of the performance of the participating teachers during the implementation of the alternative can be appreciated, although several regularities were accessed that help the conclusions and decisions to be made.

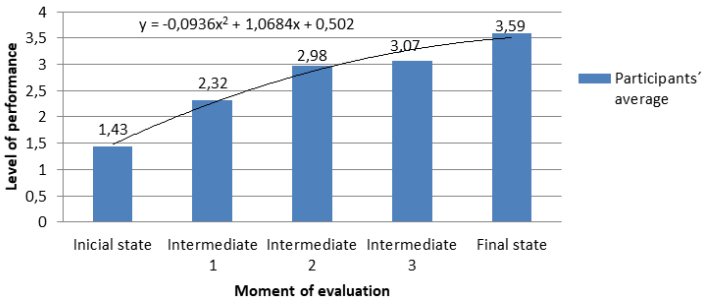

Figure 1: Performance of course participants at different moments

In this regard, although categorizing the variable and quantitative conclusions were important, the qualitative interpretation that was made was fundamental. Teacher performance was finally evaluated as above average; however, there were significant differences between the state of planning for instruction (Outstanding) and directing learning experiences, applying knowledge of subject area (Below average). Within this last dimension evaluated below average there

was an indicator that the teachers use activities, which support objectives and to accommodate varied learning styles. Such potentiality should be used to perfect the work with the rest of the indicators. In this regard, the evaluation of the other dimensions justifies the need to pay attention towards transformations in this process, and the urgency of doing so is revealed in order to meet the demands for quality in the potential services to be offered.

Potentialities were found regarding instructional objectives, mainly in matching objectives to learning assessment strategies and students' interest at the appropriate level of difficulty. This is done with a plan in which, although it is perfectible, it presents varied sequences appropriate to achieving objectives. Likewise, although it must be perfected because it is still insufficient, they provide a set of rules for acceptable behavior in students' oral participation and movement during different types of instructional activities.

In general, the indicators with the greatest difficulties were those related to the diagnosis of students' ability levels and the use of instructional materials, first and foremost in making appropriate use of educational technology. In addition, the need to stimulate reflection on the impact of Mathematics on local development and to engage students in the production of solutions was revealed urgently. For the rest, there were several indicators evaluated as average. This scenario is far from the aspirations of the requirements of the collaboration agreements established with English-speaking countries. In fact, there were some very close to below average. Among them there are those related to the use of language, as well as the management of student behavior.

As regularity, a consensus was obtained that the proposal increases the communication, reflection and exploration of the participants. This makes it possible to articulate thoughts and compare with others. In this way the integral development of the participants is promoted, the progressive transit of the dependence to independence and self-regulation is encouraged, and the development of the ability to learn in new cultural contexts such as those of English-speaking countries is encouraged. This leads them to be human, fair, discoverers, creators, entrepreneurs, transformers and audacious.

CONCLUSIONS

The novelty of this work is that the coherent articulation of interactions is undertaken at the micro level of curriculum design of Mathematics by Cuban teachers for collaboration in English-Speaking countries, from the contextualization of teaching units, using the historical-cultural approach as a basis. This leads to design the teaching-learning of Mathematics from the relationships established according to the context of the countries and the subject curriculum, with the students as the focus of this process of contextualization. This is done taking into account their actual and potential levels of development. In such way, activities which enhance the mental and emotional identification of the students are promoted.

I encourage a contextualized design of teaching units for the teaching-learning of Mathematics as a system including new curriculum organizers aimed at the potential for learning and axiology content. In addition, I reveal the need for working with organizers of the curriculum having an integral pedagogical diagnostic as background. I introduce five key contexts, for a qualitative leap that optimizes this activity.

The integration of instructive, educative and developmental points of view is in the base of the alternative proposed. The transit of the content through selection and organization processes, with organizers of the curriculum based on the results of the integral pedagogical diagnostic, contributes to improve the pedagogical training to contextualize the curriculum. The coherent articulation of the interactions, with the implemented methodology, is guided to develop harmony in education from and for the lives of those involved, so that the curriculum coherence emerges in the teaching-learning of Mathematics that Cuban teachers planned to work in English-speaking countries.

The practical significance of the above referred has an important economic, political and social impact. This way, Cuban Mathematics teachers would provide services, both inside and outside Cuba, meeting the highest international quality standards, as demanded by the Cuban economic model. They would design a curriculum that enhance their own training and consistently attend the learning context. This is enhancing the quality levels of service provided with a more contextual and professional approach.

REFERENCES

Addine, F. (2000). *Diseño Curricular*. La Habana. Editorial Pueblo y Educación.

Afanasiev, V. G. (1981). *Fundamentos de los conocimientos filosóficos*. La Habana. Ed. Libros para la Educación.

Ballesteros, C. (2002). El diseño de unidades didácticas basadas en la estrategia de enseñanza por investigación: producción y experimentación de un material didáctico multimedia para la formación del profesorado (Doctoral dissertation, Tesis en opción al Grado Científico de Doctor en Ciencias Pedagógicas. Sevilla).

Barwell, R. (2018). From language as a resource to sources of meaning in multilingual mathematics classrooms. *The Journal of Mathematical Behavior, 50*, pp. 155-168.

Borrero, R. Y. & Gamboa, M. E. (2015). La formación laboral investigativa de los profesionales de la Educación en las carreras de ciencias naturales y exactas. *Órbita Pedagógica, 2*(1), pp. 23-40.

Canceló, J. L. (1994). Un diseño formal posible de la unidad didáctica en función de las capacidades. Educación de la federación española de religiosos de enseñanza, (171).

Carmenates, O. A., Rodríguez, M. & Gamboa, M. E. (2014). Recursos didácticos para favorecer la resolución de problemas matemáticos. En S. Lima. (Ed.). *Didácticas de las Ciencias. Nuevas perspectivas (Quinta parte*) (pp. 11-38). La Habana, Cuba: Sello Editor Educación Cubana.

Castillo, Y. & Gamboa, M. E. (2016). Relaciones interdisciplinarias de las ciencias a partir de la Matemática en la Educación Preuniversitaria. *Didasc@lia: Didáctica y Educación, 7*(5), pp. 131-154.

Castillo, Y. & Gamboa, M. E. (2020a). *Funciones Matemáticas y su Didáctica para Docentes de Educación Media. Representaciones, aplicaciones y relaciones interdisciplinarias como organizadores de coherencia didáctica*. OmniScriptum Publishing Group, Mauritius: Editorial Académica Española.

Castillo, Y. & Gamboa, M. E. (2020b). *Unidades Didácticas para Matemáticas con carácter interdisciplinario. Los sistemas de representación interdisciplinar en Educación Preuniversitaria*. OmniScriptum Publishing Group, Mauritius: Editorial Académica Española.

Cisneros, D. (2006). *Perfeccionamiento del plan de preparación previa para el colaborador cubano en el área de Ciencias*. Tesis de maestría en Planeamiento, Administración y Supervisión de Sistemas Educacionales. IPLAC. La Habana.

Cruz, A. & Gamboa, M. E. (2020). Medios de enseñanza y aprendizaje para la Geometría en la formación de profesores de Matemática. *Didasc@lia: Didáctica y Educación, 11*(2), pp. 289-313.

Decroly, O. (1939). *Iniciación general al método Decroly*. Buenos Aires: Losada

De Pro, A. (1999). Planificación de unidades didácticas por los profesores: análisis de tipos de actividades de enseñanza. Enseñanza de las ciencias: *Revista de investigación y experiencias didácticas*, pp. 411-429.

Dubinina, G. A., Stepanyan, I. K., & Ganina, E. V. (2018). Specificity of Dual Language Workshop in Mathematics for Foreign Entrant Students. *Revista ESPACIOS*, 39(38).

Escamilla, A. (1992). Unidades didácticas, una propuesta de trabajo en el aula. Colección Aula Reforma. Zaragoza: Luis Vives.

Fernández, H. & Gamboa, M. E. (2016). La didáctica de la Geometría en función del desarrollo tecnológico de la Pedagogía contemporánea. *Bases de la Ciencia, 1*(1), 37-54.

Fernández, H., Gamboa, M. E., Rodríguez, M. y Alfonso, O. (2016). La Geometría asistida por Geogebra. *Boletín Redipe, 5*(2), pp. 63-70.

Fonseca, J.J. & Gamboa, M.E. (2017). Aspectos teóricos sobre el diseño curricular y sus particularidades en las ciencias. *Boletín Redipe, 6*(3), pp. 83-112.

Gamboa, M. E. (2007). *El diseño de unidades didácticas contextualizadas para la enseñanza de la Matemática en la Educación Secundaria Básica*. Tesis doctoral en Ciencias Pedagógicas. Las Tunas.

Gamboa, M. E. (2012). *Enfoque vigotskiano del curriculum en la Pedagogía contemporánea. Unidades didácticas contextualizadas*. Saarbrucken, Alemania: Editorial Académica Española.

Gamboa, M. E. (2013). Regla de Gamboa para la división entera de polinomios y triángulos de Michel para la Geometría fractal. *Opuntia Brava, 5*(3).

Gamboa, M. E. (2018a). Alternative to Train Math Teachers for Collaboration in English Speaking Countries. Diploma Paper for Bachelor's Degree in Education Specializing in Foreign Languages. Las Tunas.

Gamboa, M. E. (2018b). Statistics applied to educational research. *Dilemas Contemporáneos: Educación, Política y Valores, 5*(2).

Gamboa, M. E. (2019). La Zona de Desarrollo Próximo como base de la Pedagogía Desarrolladora. *Didasc@lia: Didáctica y Educación, 10*(4), pp. 30-50.

Gamboa, M. E. (2020a). *Errores en el aprendizaje. Utilísima semilla que debe llegar a flor y a fruto*. OmniScriptum Publishing Group, Mauritius: Editorial Académica Española.

Gamboa, M. E. (2020b). Escala estadística y software para evaluar coherencia didáctica en procesos de enseñanza-aprendizaje de Matemáticas. *Didasc@lia: Didáctica y Educación, 11*(1), pp. 140-165.

Gamboa, M. E. & Borrero, R. Y. (2016). Influence of contextualized teaching in the curricular coherence of the teaching-learning process of Mathematics. *Dilemas Contemporáneos: Educación, Política y Valores, 4*(1).

Gamboa, M. E. & Borrero, R. Y. (2017). Influencia de los organizadores del curriculum en la planificación de la contextualización didáctica de la Matemática. *Boletín Redipe, 6*(1), pp. 90-112.

Gamboa, M.E. & Borrero, R.Y. (2020). Statistical resources for research on teaching coherence. *Dilemas Contemporáneos: Educación, Política y Valores, 7*(2).

Gamboa, M.E., Carmenates, O.A. & Amat, M. (2010). El legado de Vigotsky en la profesión educativa. *Opuntia Brava, 2*(2).

Gamboa, M.E. & Carmenates, O.A. (2011). Influencia del pensamiento vigotskiano en el nivel micro del diseño curricular. *Opuntia Brava, 3*(1).

Gamboa, M.E. & Fonseca, J.J. (2014). Las unidades didácticas contextualizadas como alternativa para el proceso de enseñanza-aprendizaje de la Matemática. *Órbita Pedagógica, 1*(3), pp. 1-28.

Gamboa, M. E. & Fonseca, J. J. (2017). Los errores en el aprendizaje de las matemáticas. Su importancia didáctica. *Didasc@lia: Didáctica y Educación, 8*(5), 227-246.

Gamboa, M. E. & Santiesteban, D. (2018). División entera de polinomios: regla de gamboa y software didáctico. *REFCalE, 6*(2), pp. 33-48.

Gamboa, M. E. & Velázquez, R. Y. (2013). Implementación del idioma inglés y otras estrategias curriculares para formación integral. Ejemplos desde Probabilidades y Estadísticas. *Didasc@lia: Didáctica y Educación, 4*(7), pp. 163-179.

Garrido, C.F. & Arnáiz, P. (1999). La atención a la diversidad desde la programación del aula. Revista interuniversitaria de formación del profesorado, (36), 107-121.

Hansen- Thomas, H., & Bright, A. (2019). Teaching mathematics to emergent bilinguals. The Handbook of TESOL in K- 12, pp. 265-276.

Hickling-Hudson, A., Corona, J. & Preston, R. (2012). *The Capacity to Share. A Study of Cuba's International Cooperation in Educational Development*. New York: Palgrave Macmillan.

Joaquim, O., Gamboa, M.E. & Fonseca, J.J. (2017). Lineal functions according to the mental actions of Galperin's theory. *Dilemas Contemporáneos: Educación, Política y Valores, 4*(2).

Kilpatrick, W. H. (1918). The project method. Teachers college record, 19(4), 319-335.

López, Y. & Victoria, D.A. (2015). La enseñanza de las matemáticas en un contexto multicultural hacia un currículum intercultural. *Revista de Investigaciones UCM, 15*(2), pp. 44-55.

Makovec, D. & Radovan, M. (2015). Facilitating students' motivation and learning through competence-based didactic units. *ZbornikInstitutazapedagoskaistrazivanja, 47*(2), pp. 249-268

Marx, K., & Engels, F. (1973). Feuerbach. Oposición entre las concepciones materialista e idealista. Obras escogidas, 20.

Parra, M., Gamboa, M.E., López, J. & Borrero, R.Y. (2017). Heuristic procedures to solve mathematical problems applied to the solution of chemical problems. *Dilemas Contemporáneos: Educación, Política y Valores, 5*(1).

Rico, L. (1998). Complejidad del currículo de matemáticas como herramienta profesional. RELIME. *Revista latinoamericana de investigación en matemática educativa, 1*(1), pp. 22-39.

Sabonete, J.L., Gamboa, M.E. & Mestre, U. (2016). Propuesta didáctica para el diseño de problemas matemáticos en escuelas angoleñas de segundo ciclo. *Didasc@lia: Didáctica y Educación, 7*(5), pp. 155-164.

Santos, H., Gamboa, M.E. & Silva, N. (2017). Plane geometry: nowadays conceptions for its learning through the heuristic instruction. *Dilemas Contemporáneos: Educación, Política y Valores, 4*(2).

Silva, J.L., Gamboa, M.E. & Domínguez, A. (2019). Systematic evaluation activities for the teaching of mathematics in basic secondary education. *Dilemas Contemporáneos: Educación, Política y Valores, 7*(1).

Suh, H. (2020). Preparing Mathematics Teachers to Teach English Language Learners: What We Know and What We Can Do. In The Educational Forum (pp. 1-10). Routledge.

Torres, J. (1994). *Globalización e interdisciplinariedad: el currículum integrado*. Ediciones Morata.

Vázquez, N. & Gamboa, M. E. (2013). Competencia profesional pedagógica de profesores tuneros de Matemática y Física para enseñar en países anglófonos. *Didasc@lia: Didáctica y Educación, 4*(7), pp. 180-204.

Vázquez, N. & Gamboa, M. E. (2014). El desarrollo profesional mediante la formación permanente de los profesores de Matemática y Ciencias para trabajar en países de habla inglesa. *Opuntia Brava, 6*(2).

Voskoglou, M. G. (2019). Communities of practice for teaching and learning mathematics. *American Journal of Educational Research, 7*(6), pp. 186-191.

Waller, P. P., & Flood, C. T. (2016). Mathematics as a universal language: transcending cultural lines. *Journal for Multicultural Education, 10*(3), pp. 294-306.

Wilkinson, L. C. (2019). Learning language and mathematics: A perspective from Linguistics and Education. *Linguistics and Education, 49*, pp. 86-95.

Zaldivar, L., Cruz, Y. & Gamboa, M. E. (2015). Mediación didáctica contextualizada de las tecnologías de la Información y la Comunicación para la fijación de los conceptos matemáticos. *Didasc@lia: Didáctica y Educación, 6*(1), pp. 49-68.

Zilberstein, J. & Silvestre, M. (2000). *Enseñanza y aprendizaje desarrollador*. Ediciones CEIDE. México.