TITLE: CONTEXTUALIZED TEACHING: CHALLENGES AND OPPORTUNITIES IN TEACHING SECONDARY SCHOOL MATHEMATICS IN PUERTO RICO

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Date of completion: January 23rd, 2025

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Summary

This study describes the experiences of secondary-level mathematics teachers from the Department of Education of Puerto Rico implementing the strategy of contextualized teaching. Qualitative research framed in phenomenology was conducted, collecting data through semi-structured interviews and a review of normative documents from the Department of Education. The findings provide valuable information about the use of contextualized teaching, the perception that teachers have of this strategy, as well as the challenges that participants face in its implementation. Some of the challenges they face during its implementation are limited resources and needs of teacher support. As a contribution to this research, a manual and a website were designed as teacher support tools for the implementation of contextualized teaching in secondary-level mathematics classes.

Keywords: contextualized teaching, secondary mathematics, qualitative methodology, educational challenges, Puerto Rico.

Introduction

This article is based on research conducted as part of a doctoral dissertation entitled *Phenomenological Study in Secondary Schools in the Northern Area of Puerto Rico on the Use of the Contextualized Strategy in the Secondary Mathematics Class* , developed in the Doctoral Program of Caribbean University of Bayamón, Puerto Rico. Contextualized teaching, according to the *Mathematics Curriculum Framework of the Department of Education of Puerto Rico* (2016), is based on interesting and relevant contexts for the student. In addition, it establishes that this strategy considers the processes and uses understanding, discovery, and connections in

teaching. Based on this definition, the Mathematics Program of the Department of Education of Puerto Rico (PRDE) recommends implementing the contextualized teaching strategy in the classroom to guide learning experiences successfully. In turn, many studies affirm the benefit of contextualized teaching for the learning of mathematics (Prastiwi et al. 2019). However, for years it has been observed that PRDE students show a low level of proficiency in this subject, specifically, proficiency begins to decline from sixth grade to twelfth grade (PRDE, 2024). Mathematics has taken a leading role in our modern society, being fundamental for daily life, the educational and work fields. Mathematics is the basis for modern technology, from artificial intelligence to data analysis, computer science and cybersecurity. Therefore, it is alarming that high school students do not show a high level of proficiency in mathematics, when these are necessary to respond to the requirements of this modern era. These elements make it necessary to understand the educational practices of mathematics teachers implementing the contextualized teaching strategy. The purpose is to understand why a high level of proficiency in mathematics at the secondary level is not being achieved, despite the demonstrated effectiveness of this strategy in previous studies.

Theoretical and conceptual framework

Contextualized teaching is supported by two learning theories; Piaget's constructivism (1972) and Lave and Wenger's situated learning (1991). The combination of these two theories provides a solid basis for understanding the use of the contextualized mathematics teaching strategy in the context of secondary schools. Constructivism, on the other hand, maintains that learning occurs when the student actively engages in the process and relates new knowledge to his or her previous experience (Brooks and Brooks, 1999). While situated learning maintains that knowledge is constructed through participation in practice (Lave and Wenger, 1991).

Furthermore, situated learning establishes that learning should take place in authentic contexts, in which the student is involved in meaningful and relevant activities. Regarding the role of the teacher, constructivism describes him or her as a facilitator, who should provide the student with the necessary tools to construct his or her own knowledge. Situated learning theory, on the other hand, establishes that the role of the teacher takes on great importance in lesson planning. The lesson should consist of authentic and relevant educational tasks for the student.

Methodology

This research was conducted using a qualitative methodology based on phenomenological design. This design was appropriate since it allowed for a deep understanding of the educational practices of the participants with this teaching strategy. Phenomenological research is characterized by focusing on the subjective experiences of people, and thus the researcher can identify patterns and structures that are part of those experiences. By using this research method to study the experience of teaching practices of secondary level Mathematics teachers, phenomenology not only provides a means to acquire subjective knowledge and raw perception but is also sufficiently rigorous and systemic to represent the experience in the classroom.

Population and Sample

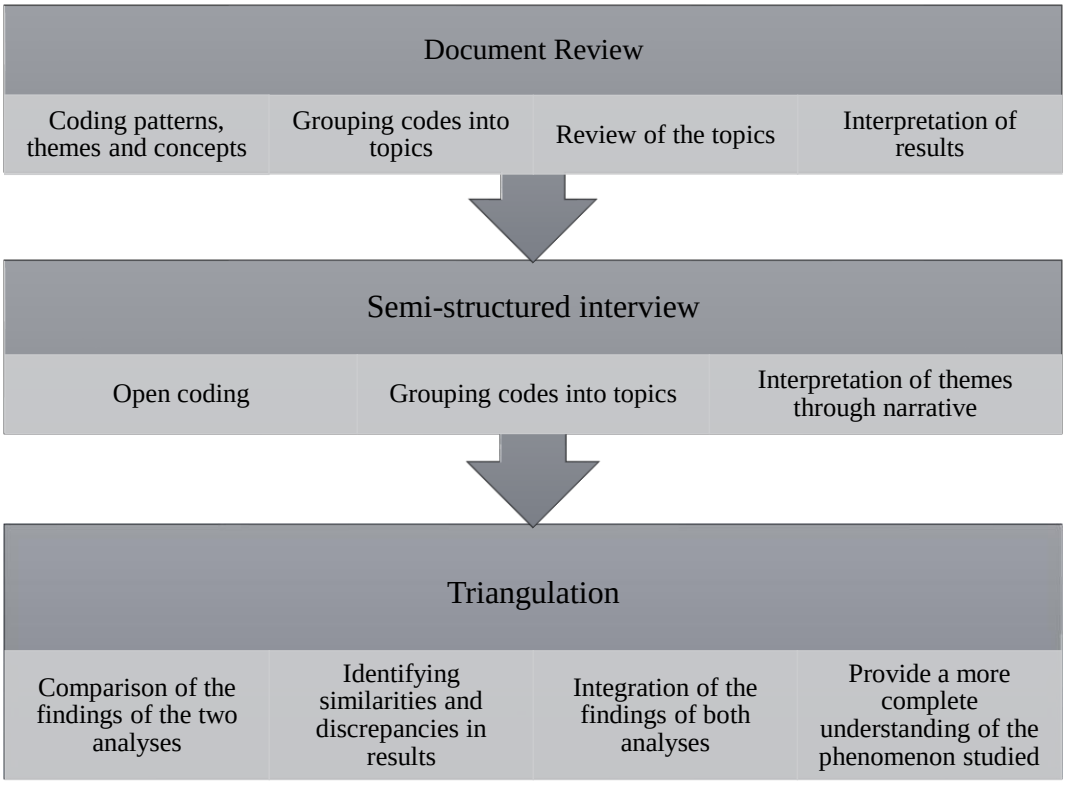
The study population included secondary level mathematics teachers from public schools in the northern area of Puerto Rico, which includes the Regional Educational Offices of Bayamón and San Juan. The sample, selected through criterion sampling, was composed of 7 teachers with at least five years of teaching experience, certification in secondary level mathematics granted by the DEPR and who have implemented the contextualized teaching strategy in algebra, geometry or trigonometry courses.

Data Collection

The data collection techniques used for this research were semi-structured interviews and document review. The interviews allowed participants to describe their experiences and practices in detail, while the document review offered valuable information for a clearer context in the interview question guide and subsequent analysis of the collected data.

Data Analysis

Two types of analysis were conducted on the data collected: Wolcott's qualitative analysis model for the data obtained from the interviews and Braun and Clarke's model for the document review. The aim of Wolcott's (2001) analysis is to identify common patterns and themes that emerge from the data, as well as to discern differences and variations in the participants' experiences and perspectives. Whereas Braun and Clarke's (2006) analysis of the data obtained from the document review allows for the identification, organization and analysis of significant patterns in the texts, allowing for a systematic and rigorous interpretation of the relevant normative information. Finally, triangulation was done to strengthen the validity and robustness of the findings from both the interviews and the document review. The following diagram illustrates the order of the steps for each of the data analyses and the triangulation process:



Findings

This research provides valuable information about the experiences and practices of seven secondary level mathematics teachers in Puerto Rico when implementing the contextualized teaching strategy. The findings reveal how these teachers define and implement this strategy, emphasizing the benefit in student engagement and understanding. The findings also reveal the significant challenges faced by the participants, such as the abstract nature of some secondary level mathematics skills, the lack of adequate academic resources, and the rigor of planning classes aligned with curricular standards.

The findings of this research are organized around the research questions that guide the analysis of how teachers perceive, implement, and face the challenges of this pedagogical strategy. These questions explore key aspects: What knowledge do teachers have about contextualized teaching?

What are the practices they apply in the classroom to make it effective? How do they integrate this strategy into their daily planning? What challenges do they encounter when implementing it? And how do these practices reflect what is established in the normative documents of the Mathematics Program of the DEPR? This qualitative analysis allows us to reflect on the challenges and opportunities in the teaching of mathematics, allowing us to make specific recommendations on how to strengthen these practices in the local educational context.

Key findings

Knowledge and understanding of the contextualized teaching strategy

Participants varied in their definition of contextualized teaching in the specific context of secondary level mathematics. Some highlighted the integration of mathematical topics and concepts with real-life situations, while others defined contextualized teaching as a strategy of teaching based on experiences known to students. Likewise, there is a varied level of understanding among participating teachers, from those who feel confident contextualizing mathematical topics to those who admit to having difficulties in doing so. For example, participant two expressed: “my understanding of this topic is not great because I cannot contextualize some topics”, while participant three stated “My understanding is quite good, I always educate myself, because students have to be kept interested and motivated, and if they are not taught in context, they are not interested”. This adaptation of content to daily life represents a revealing innovation in the pedagogical teaching-learning practice, since it implies a re-evaluation of traditional methods of teaching mathematics. Bature (2020) talks about a similar scenario in which Mathematics teachers in Nigeria decided to change their philosophy and developed strategies to improve their effectiveness, leaving aside traditional teaching in favor of contextualized teaching based on a constructivist philosophy.

Practices of participating teachers

Regarding the findings of how teachers adapt mathematical concepts to real-life situations, they employ a variety of approaches to implement contextualized teaching in the mathematics classroom. This variety consists of creating activities in lesson planning, using real-life examples, and integrating current problems into the curriculum. Participants express prioritizing the practical application of mathematical concepts in everyday, real-world situations. Practices such as solving problems based on current events, discussing practical applications of mathematics, and creating activities that reflect students' personal experiences are highlighted. This is in line with the study by Reyes et al. (2019) who highlights how some teachers apply contextualization in their geometry classes, using students' lives as a relevant context and taking advantage of the resources available in their environment for teaching. This study suggests that some teachers have a solid understanding of how to apply contextualized teaching in their teaching practice. Among the findings of this study, the diversity of mathematical skills taught in a contextualized manner is observed; however, the patterns that emerge from the responses are the application to real situations. For example, participant one mentions: "the concepts that I am working on the most are geometric and statistical concepts." While participant two highlights: "the greatest skill that I teach in a contextualized manner is any concept that relates to money." In addition, participants express experiencing greater participation and understanding by students, as well as an increase in interest and motivation towards mathematics.

Challenges identified

The participating teachers express that they face various challenges when planning secondary mathematics classes. The data collected show that the challenges are adapting the content to everyday situations and the need to follow the established curriculum. Participant three expresses

that a constant challenge is to integrate real-life situations without deviating from the academic and curricular objectives. He also expresses that "unfortunately, the Department (referring to the Puerto Rico Department of Education) has calendars that they say you have to follow because they tell you that the META tests (referring to the standardized tests) come on a certain date." Participant four also mentions "having to follow the curriculum" as a challenge.

Likewise, participants expressed that there is resistance to change on the part of students, who may be accustomed to more traditional teaching methods. In this sense, both participant two and participant four highlight the resistance of students to leave their *comfort zone,* which can make the implementation of contextualized teaching difficult. Participant four said, "The resistance of students to leave their *comfort zone,* don't believe it, sometimes they are already used to being given exercises on the board and in a notebook and doing it mechanically."

Another challenge identified is the lack of adequate resources and materials to carry out contextualized teaching in secondary mathematics. Teachers point out the need for updated resources and specific teaching materials to implement this strategy effectively. For example, the participant says, "the shortage of adequate materials and tools can represent an obstacle to contextualized teaching, especially when it comes to creating meaningful connections between mathematical concepts and the students' environment."

Relevance of the Normative Documents of the Mathematics Program of the DEPR

The findings of this research highlight that participants agree on the importance of having official mathematics program documents. However, it was identified that participants have limited knowledge of the content of the documents. Only participant two stated that "the 2016 mathematics curriculum framework establishes problem solving and contextualization of teaching as learning strategies." While the other participants express that they know that the

document exists but that they are unaware or have little memory of the specific details of the curriculum framework and its relationship with contextualized teaching. According to participant 3, participant 4, participant 5, participant 6 and participant 7 express ignorance or lack of mastery over the specific details of the curriculum framework. “I don’t know” (participant 4), “I don’t master it completely” (participant 5), “I don’t remember, that is, I have read it, but it was a long time ago” (participant 7). On the other hand, participant 4 says “an important element would be to give workshops, because over time one forgets what the documents say. Likewise, Participant 6 mentions the importance of integrative workshops for teachers, indicating that “these workshops should provide visual examples to facilitate their understanding and application in the classroom.”

These scenarios presented by the participants are reinforced by studies such as that of Adolphson (2014) who establish that the implementation of contextualized teaching involves facing a series of challenges, including lack of time and resources, difficulty in finding the appropriate real-world context and resistance from students who are not familiar with this type of teaching.

Conclusion

The problem statement of this research arises from the need to understand the practices of secondary level mathematics teachers implementing the contextualized teaching strategy. This topic is very relevant to the low academic achievement of secondary level students in the Department of Education of Puerto Rico, with this strategy being described as a strategy that improves mathematical skills. The findings obtained in this research offer valuable data that help to understand the use of contextualized teaching, thus contributing to the formation of a perspective with foundations on how to support the teacher. By providing teachers with the tools that promote an effective implementation of contextualized teaching, an improvement in

teaching practices is expected, which in turn contributes to greater academic achievement by students.

The findings show a diversity in the definitions and understanding of the contextualized teaching strategy. However, the participants recognize this area of opportunity, which reflects self-reflection and commitment to professional development. Likewise, the participants recognize the relevance of connecting mathematical concepts with concrete situations and practical applications in the daily lives of students. This reflects an effort on the part of the teachers who participated in the research to involve students and connect mathematical concepts with their daily lives to increase understanding of learning. Likewise, the findings conclude that, although the participants express the importance of the normative documents of the mathematics program of the DEPR, there is a gap between these documents and the knowledge that the participants have. In addition, the findings reveal a lack of adequate training and support to ensure effective application.

On the other hand, as part of the challenges, the participants expressed that students show resistance to a type of class with contextualized teaching. This coincides with what was established by Barrera and Rodríguez (2019) who share the concern about the resistance and motivation of secondary level students, recognizing that achieving active participation in classes where the contextualized teaching strategy is implemented can be complicated, especially when students are accustomed to more traditional methods. However, the participating teachers highlight the importance of overcoming these challenges and emphasize the importance of giving students time to adapt to the new methods. In addition, this study underlines that, despite the resistance shown by students, with time and accommodations, students can overcome it and show motivation and interest in contextualized classes.

Finally, the need for actions to respond to the identified areas of opportunity is highlighted, such as the need for resources or teaching guides for the implementation of the strategy, student resistance and the lack of training on the content of the normative documents of the mathematics program. In response to these needs, specific tools were developed such as the Contextualized Teaching Module in Mathematics at the secondary level and a *Google Site.* Both tools are designed to offer teaching support to teachers in the implementation of the contextualized teaching strategy.

This research not only identifies the challenges and areas of opportunity in the implementation of contextualized teaching but also presents precise recommendations and contributions to transform educational practices in the secondary mathematics classroom, establishing a path towards a more effective educational future for Puerto Rico.

Contributions

A key finding of this research is the emphasis on the growing need to provide teachers with practical and directly applicable training and professional development in the classroom, beyond traditional theoretical frameworks. In response to this need, this research leads to the development of an innovative module: a bank of mathematical exercises aligned with the content standards of the Mathematics Program of the Department of Education of Puerto Rico, specifically designed to facilitate the implementation of the contextualized teaching strategy. The module entitled Contextualized Teaching Module *in Secondary Level Mathematics* It was officially published by the DEPR and is accessible to all teachers. This module includes two specific exercises for each content standard of the Mathematics Program of the Department of Education of Puerto Rico, for a total of ten exercises. Each exercise has the content standard, the expectation and the indicator, the learning objectives, the activation of prior knowledge, the

introduction to the contextualized topic, the verbal exercise, the instructions, the guiding questions and the closing.

One example included in the module is the exercise titled “Awareness Campaign on Responsible Use of Technology.” The learning objectives of this exercise are to solve problems involving expressions, equations, and functions, create graphs, and collect data. Through this activity, students will conduct a survey about the time their peers at school spend on electronic devices during a typical week. This type of activity directly connects mathematical concepts to a real-world problem relevant to students, fostering both meaningful learning and critical thinking.

Google Site , https://sites.google.com/view/contextualizadamatematicas/ was developed , designed to serve as a holistic and accessible tool for educators. This site covers various aspects of contextualized teaching in the mathematics classroom. One of the most relevant elements of the *Google Site* is a collaborative forum for teachers to share their own experiences and resources, thus promoting a community of professional learning and practice; in addition to research articles and pedagogical theories that support contextualized teaching.

The contextualized teaching strategy is recognized by several studies as an effective strategy to motivate secondary level students and promote meaningful learning in mathematics (Boaler, 2015; Priyadi and Yumiati, 2021). For effective implementation, teacher training and support are important and necessary. The advances of this society make it worthwhile for students to be trained in mathematics skills to be functional citizens in the face of labor, society, and technological demands. Educational communities are called upon to continue collaborating and sharing their educational experiences so that these translate into better academic achievement in the subject of mathematics for students in Puerto Rico.

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