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ECTIVENESS OF ACTIVE LEARNING AND SELF ASSESMENT OF FIRST YEAR MIDDLE SCHOOL STUDENTS' MATHEMATICAL COMPETENCIES: AN ETHNOMODELLING APPROACH

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Abstract: The reason for this study was on the growth of ethnic and linguistically diverse student populations in schools. An important change in mathematics instruction needs to take place in order to accommodate changes in student populations, thus there is a need of a pedagogical tool that will enhance cognition and build mathematical competencies. Therefore, the main goal of this research is to find out how self-assessment and active learning can build learners mathematical competencies using an ethnomodelling approach. The major finding of this research will be to accomplish equality among students, thus incorporating ethnomathematics into lessons. In this regard, mathematical knowledge will to be made equal for all students.

Keywords: Ethnomodelling, Self-Assessment, Mathematics Competencies.

INTRODUCTION

The term 21st century in Mathematics education is generally used to refer to certain core of competencies such as collaborative mathematical literacy, matheracy, and technocracy related to a Trivium Curriculum (D'AMBROSIO, 1999), which is connected to Ethnomathematics critical thinking, and problem solving that advocate school needs to teach and help students to become critical and reflective citizens.

Thus, teaching and learning of mathematics is a product of interaction among teachers, students, and mathematics. Embracing a 21st century learning model requires that teachers consider innovative elements such as active learning, self-assessment, and other students centered pedagogical approaches that may create a shift in crating learners who will take intellectual risks, fostering learning dispositions, and nurturing school communities, including local communities that are part of the schools' contexts, where everyone is an active learner.

With the growth of ethnic and linguistically diverse student populations in schools, curricula should reflect the intrinsic, social, and cultural learning of students. In this context, teachers should be supported in their preparation to address such differences. Ethnomathematics draws from the sociocultural experiences and practices of learners, their communities, and society at large, using them not only as vehicles to make mathematics

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learning more meaningful and useful, but, more importantly, to provide students with insights of mathematical knowledge as embedded in diverse environments.

Hence, it is necessary to investigate the effectiveness of self-assessment, active learning pedagogy of first year middle school students, as well as mathematics competencies by using an ethnomodelling approach by applying a qualitative approach based on the adaptation of Grounded Theory, which deals with theoretical sampling, open coding (preliminary codes), and axial coding (conceptual categories) that will help the investigator to answer the research question of this study.

ETHNOMODELLING, TRIVIUM CURRICULUM, AND MATHEMATICAL COMPETENCIES

Ethnomathematics is a program that incorporates mathematical ideas and procedures practiced by the members of distinct cultural groups, which are identified not only as indigenous societies but as groups of workers, professional classes, and groups of children of a certain age group as well. According to Rosa and Orey (2013), there are four major innovative approaches in Ethnomathematics, which are: Social Justice, Ethnocomputing, Trivium Curriculum and Ethnomodelling. For emphasis, this paper will be centering on the Ethnomodelling and the Trivium Curriculum.

Ethnomodelling approach is the use of ethnomathematics assumptions and the application of tools and techniques of mathematical modelling that allow us to perceive reality by using different lenses, which gives us insight into mathematics performed in a holistic way (ROSA; OREY, 2013). These approaches are socially rooted constructs that include the cultural aspects of mathematical knowledge in the modelling process. For example, the use of the practice of cubic content calculation (*cubação*) and the mathematization of people of Tipi as a pedagogical proposal to elaborate activities for the teaching and learning of mathematics show the importance of the contextualization of problems in the learning environment through the connection of ethnomathematics and culturally relevant pedagogy concepts.

The trivium curriculum for mathematics is composed of literacy (communicative instruments), matheracy (analytical instruments), and technoracy (material and technological instruments), which enables the development of school activities based on an ethnomathematics and modelling foundation.

1) *Literacy*: In the modelling perspective, teachers guide students to select a topic through dialogue and discussion. Themes are very general in nature and allow students to engage in mathematical exploration and creativity. The implementation of mathematical modelling precedes an ethnographic investigation of systems found in diverse school communities that can develop ethnomathematical procedures and practices (ROSA; OREY, 2015).

2) *Matheracy*: In a modelling perspective is the ability to interpret, manipulate, and handle signs, symbols, and codes as well as to propose the elaboration and use of mathematical models in everyday life related to diverse environments in order to use procedures and strategies developed locally in an ethnomathematical perspective (ROSA; OREY, 2015).

3) *Technoracy*: In the modelling process is the incorporation and use of diverse tools that include calculators, computers, softwares, computational programs, and simulators (active learning), which enhance the development of mathematical competencies that are also found in the practices developed by the members of the school community (ROSA.; OREY, 2013)

Self-assessment is a tool used by students to evaluate the quality of their work, measure their performance with the stated goals and learning objectives, identify area of strengths and weakness in their work and implement revision accordingly. It is an essential stage that gives feedback to the students and the teachers on the progress of learning (ELN, 2019). Thus, Andrade, Du, and Mycek (2010) affirmed that "Self-assessment is a process of formative assessment during which students reflect on the quality of their work, judge the degree to which it reflects explicitly stated goals or criteria, and revise accordingly" (p. 199).

Active learning is an approach to instruction that involves actively engaging students with the course material through discussions, problem solving, case studies, role plays, and other methods. It is paramount in combining active learning with a self-assessment component in supporting students' cognition skills. Self-assessment intervention needs to be implemented to ensure that mathematics mastery is at the achieved level.

This approach also provides teachers with rich resources of evidence to draw upon as a working document that gives an insight into students' abilities, opinions, feelings, understandings, and misconceptions. When assessment and active learning is fully embedded in a classroom, then students are able to be *self-efficacious*[2], steer their own learning, their self-

[2]Self-efficacious individuals focus on their future and develop possible success scenarios of their actions Therefore, they are expected to be more committed to planning. They may experience a low level of negative

esteem and motivation is high therefore mathematics competency related to the mastery of mathematical contents may be achieved (NATIONAL ACADEMIES OF SCIENCES, ENGINEERING, AND MEDICINE, 2018).

Mathematical competencies are the ability to develop and apply mathematical thinking in order to solve a range of problems in everyday situations, it is important to point out that the emphasis is on the process and activities, as well as knowledge. Mathematical competence involves, to different degrees, the ability and willingness to use mathematical modes of thought (logical and spatial thinking) and presentation (formulas, models, constructs, graphs, and charts) (NISS; HØJGAARD, 2011).

In this regard, Niss and Højgaard (2012) state that mathematical competence is the ability to understand, judge, do, and use mathematics in a variety of intra-and extra-mathematical contexts and situations in which mathematics plays or could play a role. This author identifies eight competencies that were divided into two groups. The first group refers to *the ability to ask and answer questions in, with, and mathematics* that is composed by mathematical thinking, problem tacking, modelling, and reasoning competencies, and the second group refers to *the ability to deal with mathematical language and tools* that is composed by representing, symbolism and formalism, communicating, and aids and tools competencies.

INTERACTION BETWEEN ETHNOMODELLING SELF ASSESSMENT AND ACTIVE LEARNING

Ethnomodelling approaches are intended to make school mathematics more relevant and meaningful to students in order to increase the overall quality of education and assert more culturally relevant views of mathematics. In this regar, Rosa anda Orey (2013) states that this pedagogical approach is achieved through dialogue (self-assessment) when community members, teachers, and students discuss mathematical themes that help them to work on problems that are directly relevant to their community.

In this context, through self-assessment, students investigate conceptions, traditions and mathematical practices developed by members of distinct cultural groups in order to incorporate

emotions in a threatening situation and, as a result, they may feel capable of mastering diverse situation (BANDURA, 1997).

them into the mathematics curriculum. Thus, self-assessment promotes de development of ideas, objectives, procedures, and practices developed by the members of distinct communities that enables the attainment of mathematical knowledge. When students are encouraged to examine mathematical activities in their own sociocultural contexts, they realize that mathematics procedure and practice are not trivial as they see them connected to their daily lives (ROSA; OREY, 2013).

Culturally designed tools provide a flexible learning environment that enables students to reconfigure the relationship between cultures, mathematics and technology, which deals with active learning. Therefore, ethnomodelling practices involve numeric relations found in measuring, classification, calculation, games, divination, navigation, astronomy, modelling, and with a wide variety of other mathematical procedures used in the production of cultural artifacts (EGLASH, BENNETT, O'DONNELL, JENNINGS; CINTORINO, 2006).

A connection of ethnomodelling and active learning can be observed in research conducted by Eglash et al. (2006) that is based partially on West African content by developing a computer software called *Culturally Situated Design Tool*, which allows students to create and modify patterns from traditional culture on their own. Consequently, this research will focus on the use of GeoGebra software as an active learning pedagogy (technoracy), self-assessment (literacy) to ascertain the development of mathematics competencies (matheracy) of first year middle school students.

RESEARCH QUESTION

How can first year middle school mathematics teachers integrate an active learning pedagogy and students' self-assessment to enhance the development of mathematical competencies, equity, and social justice in their classrooms in an ethnomodelling perspective?

FINAL CONSIDERATIONS

Any study of self-assessment and active learning represents a powerful means of validating how well students have attained mathematics competencies. Thus, the integration of these pedagogies by using ethnomodelling approach to meet specific needs of the diverse students' population, as well as the desired learning that may help them to become active participants in the classroom instructions and activities.

In the mathematics classroom there exists a need to create a new role to mathematics instruction that empowers students to build competencies by considering the effect of self-assessment and active learning pedagogy on student's mathematical knowledge. In this regard, Rosa and Orey (2013) affirms that ethnomodelling can be considered as a pedagogical action that translates mathematical ideas and procedures as cultural conduits of mathematical practices found in the students' communities.

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