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Original Article

Connecting Ethnomathematics to the Concept of Positive Deviance

Daniel Clark Orey and Milton Rosa

Departamento de Educação Matemática
Universidade Federal de Ouro Preto

Email: oreydc@gmail.com and milrosa@hotmail.com

 0000-0002-8567-034X,  0000-0002-5190-3862

Abstract

An impasse in mathematics education is related to its frequent lack of acknowledgment of local mathematical practices in its research theoretical basis. Pedagogical action of ethnomathematics aids in recording cultural-historical forms of mathematical procedures and practices developed by members of distinct cultural groups. Ethnomathematics is a form of push back from colonization without attempting to replace academic mathematics. Hence, a sense of *insubordination* triggered by ethnomathematics is *creative* and often evokes a sense of disturbance that causes a conscious review of rules and regulations endemic to many curricular and educational research contexts. This process enables educators and investigators to adopt *positive deviance* in developing pedagogical actions that deal with content usually disconnected from the reality of the students in order to deal with imposed norms and rules. Thus, positive deviance involves an intentional act of bending the rules in order to serve the greater good of the school communities.

Keywords: *Cultural groups. Ethnomathematics. Pedagogical action. Positive deviance.*

Initial Considerations

Ethnomathematics is a form of pedagogical action that offers a contrast to the traditional academic, dominant and Eurocentric discourse in mathematics education. As well, it brings attention to school curricula often imposed on local communities during the process of colonization. It also challenges the view that members of local and/or distinct cultural groups only develop exotic and/or simplistic mathematical ideas, procedures, techniques, and practices.

In this context, the development of ethnomathematics can be interpreted to some extent as a reaction to cultural imperialism, which has spread around the world beginning in

the 15th century with the movement of the great navigations. This reaction can be connected to the concept of positive deviance¹ (Zetlin et al., 1990) as it relates to the flexibility of rules and regulations in order to achieve a deeper understanding of what constitutes mathematical thinking and reasoning. In this article, the holistic understanding of positive deviance embraces innovative solutions in the ethnomathematics research and its pedagogical action because this program also relates to the flexibility of norms in the educational institutions.

For example, in a study conducted in Brazil, Duarte (2004) investigated the specificity of mathematical ideas, procedures, and practices produced by adolescent and adult construction workers who were also students in an evening adult education course. The results of this study showed that mathematical knowledge produced, developed, and transmitted in construction sites has important curricular implications inferred from this kind of knowledge production. It also studied the connections of the local knowledge along with the forms of academic knowledge legitimized by the school in order to determine curricular modifications. It was found that these connections had positive results in the development of mathematics curriculum in schools.

During investigations seeking to understand and comprehend the development of local mathematical knowledge, researchers and educators may be faced with a set of specific characteristics related to ideas, procedures, and mathematical practices that are different from those studied in the academy (Rosa & Orey, 2015). This aspect of positive deviance of ethnomathematics can assist in resolving ethical dilemmas encountered during investigations related to sociocultural issues.

Hence, the concept of positive deviance refers to the practices that, in an insubordinate, creative subversive, and responsible way, and with discernment, are opposed to educational practices that make no real pedagogical sense, especially in regards to the educational bureaucracies and traditions of public policies imposed on students and to the school communities. This refers to actions assumed in relation to norms and institutional rules which aim at better commitments in the needs of students who compose the school population (Rosa & Orey, 2017).

Both researchers and educators who are able to create innovative alternatives to achieve better results for the common good of the community and which are constituted by their colleagues, students, parents, school administrators, can be candidates for positive change (D'Ambrosio & Lopes, 2015). This action is often in opposition and generally represents a challenge to established authorities and long-beheld traditions, even if it they are related to, or cause unintentional exclusion and/or discriminatory school policies.

For example, a wide variety of mathematical procedures, strategies, and techniques challenge primitivist² views held by members of distinct cultural groups as ideas that possess simplistic mathematical knowledge used to solve problems they face in their communities. It also challenges epistemological stereotypes most damaging to these members. Thus, a sense of positive deviance becomes an important source for adaptive transformational capacities by members of distinct cultural groups that produce non-conformist actions. Its main objective is to modify these norms and rules by applying inclusion, innovation, creativity, and adaptability (Rosa & Orey, 2015).

¹The concepts of *creative insubordination* (Crowson; Morris 1982), *responsible subversion* (Hutchison, 1990), or *positive deviance* (Zetlin et al., 1990) are equivalent as they relate to the adaptability of rules and regulations in order to achieve the welfare of the members of distinct cultural groups. However, there are subtle conceptual differences that must be discussed during the development of investigations.

²Primitivism refers to cultures believed to lack cultural, social, technological, or economic sophistication or development. Historically, primitivism has been used to justify conquering the members of *other* cultural groups. In cultural terms, primitivism means a deficiency in those qualities that have been used historically in the Western as indicators of civilized cultures (Rhodes, 1995).

Positive deviance refers to when researchers and educators gain a certain sense of awareness about when, how, and why to act against established procedures or guidelines that are unjust, racist, homophobic or unfavourable to any member of a school community. This means that individuals, who are positively deviant, according to D'Ambrosio and Lopes (2015), are subversively responsible because they assume that members of distinct cultural groups are unfinished human beings who take criticality, creativity, responsibility, and curiosity as the foundation of an ongoing and transformative process of the production of knowledge.

Ethnomathematics can be considered both a positive and deviant pedagogical action because it causes a certain disruption to the existing order in academic mathematics by encouraging and developing the study of the mathematics found locally including diverse mathematical ideas, procedures, and practices that are in accordance to the emic³ perceptions of the members of distinct cultural groups (Rosa & Orey 2017). It is important to state that much of the antipathy towards ethnomathematics is precisely because it has broken the rules and bureaucratic expectations of traditional academic mathematics.

Through ethnomathematics, it is possible to recognize divergent ways, as well as value the diverse modes that mathematical knowledge is produced by other cultures and environments (Rosa & Orey, 2015). It is necessary to reclaim contributions of the conquered, minority, or marginalized peoples in the development of mathematical knowledge. Ethnomathematics generates a new respect for diverse forms of mathematical knowledge and assists in resolving ethical dilemmas involved in these investigations.

Therefore, a sense of positive deviance can be triggered by initiating a disturbance that causes a review of traditional or western academic mathematical knowledge by increasing the potential for growth and the emergence of new opportunities for the discussion of the nature of the mathematics curriculum. Positive deviance contributes to the confrontation of taboos or outright hostility towards assumptions suggesting mathematics is a universal⁴ field of study without traditions and cultural roots (Rosa & Orey 2015).

Mathematical knowledge is acquired through unequal cultural interactions and conflicts, which reflect the dynamics of the cultural encounters. Ongoing, indeed universal, challenges that many educators face in mathematics education can develop methodological procedures that help teachers to understand culturally bound mathematical ideas, procedures, and practices developed by members of distinct cultural groups without letting their own culture interfere with the cultural background of others. In this regard, Rosa and Orey (2019a) affirm that many members of distinct cultural groups developed their own interpretation of the local culture (i.e., emic approach) opposed to the outsiders' global interpretation (i.e., etic approach) of that culture.

Contextualizing Positive Deviance and Ethnomathematics

Decision-making in the teaching and learning process contains multiple conditions of certainty, uncertainty, and risk. For example, many diverse pedagogical settings contain an infinite assortment of situations that require teachers to use technical skills, a professional

³The emic and etic approaches were developed by Pike (1967) from a distinction in linguistics between *phonemic* and *phonetic*. In their original meanings, phonemics refers to examination of sounds for their meaning-bearing roles in a particular language, while phonetics denotes study on universal sounds covering all languages.

⁴Universals can be perceived to the extent that members of distinct cultural groups order, count, pattern, problem solving, and model. However, how these members, outside of the academic world do and develop mathematical activities is part of the diversity that ethnomathematics seeks to study, share, and promote (Rosa & Orey, 2017).

code of conduct, and situation-specific knowledge. One size fits all mathematical standards may not be realistic for implementation of curricular activities at a local level (Rosa & Orey, 2017).

Teachers may be forced to deviate, react creatively, responsibly, subversively in meeting the educational needs of their students. The term deviance can be emotionally charged, evoking a wide range of images and interruptions, most of them likely to be aberrant or elicit disapproval (Rosa & Orey, 2017). Thus, we propose that teachers use positive deviance to develop actions in order to deal with such situations because it “involves an intentional act of breaking the rules in order to serve the greater good” (Gary, 2013, p. 26).

However, deviations can be described as a normal part of the process of any work (Polet et al., 2003). The concept of positive deviance first appeared in nutrition research in the 1970s. Investigators observed that despite the poverty in certain communities, some poor families had well-nourished children (Zeitlin et al., 1990). Researchers suggested using information gathered from these families to plan alternative nutritional programs (Wishik & Van der Vynckt, 1976).

The term positive deviance has also been used in broadening the discipline of organizational behaviour (Dodge, 1985). Positive deviance is a term which is widely used throughout business, management, sociology, criminology, healthcare, and nursing. However, as concepts are a basis for theory building, an understanding of the notion of positive deviance may indeed contribute to development of innovative knowledge in the teaching and learning process that is linked to the cultural context of the students. Yet, it is important to state here that there is no uniform or consistent definition of this concept for educational contexts.

We understand positive deviance as the unprescribed practices or strategies that produce better outcomes than traditional standard practices (Pascale et al., 2010). This idea can be related to the teaching and learning processes in regard to the use of local techniques in mathematical thinking, measurement, and solving problems faced by members of distinct cultural groups in their daily lives. According to Tarantino (2005), an act of positive deviance becomes both intentional and honourable behaviour that differs from the established norms because it contains elements of innovation, creativity, and adaptability.

Ethnomathematics-based investigations have revealed the cultural influence in the evolution of world-wide mathematical knowledge through the study of historical accounts, which helped the analyses of ideas, procedures and mathematical practices developed locally, which are aimed at deconstructing the dominant mathematical discourse by offering innovative views about the nature of this knowledge (Ascher, 2002; Orey, 2000). Acknowledging local mathematical knowledge as well as its implications for social justice, cultural empowerment, and political transformation of a society triggers the development of positive deviance, and encourages debate about the true nature of mathematics as it relates to culture and society.

In this sense, positive deviance is used in this process when the norms and rules used in academic mathematics in these programs are inconsistent with the mathematical knowledge developed in terms of the local reality of the students. It is necessary to emphasize the pedagogical action developed in many mathematics curricula that ignore this important connection between academic knowledge and practices developed by community members.

Thus, to reduce the gap between theoretical and practical knowledge in the school curriculum, there is a need for teachers to query possible connections between the mathematical knowledge developed in local and community contexts and that which are practiced and supported by the academic environments. In this context, educators experimenting in positive deviance contribute to the generation of new ideas and develop a

respect for diverse forms of mathematical knowledge. As well, they assist in resolving ethical dilemmas involved in investigations in this area of study.

During investigations seeking to understand local mathematical knowledge, educators may be faced with a set of specific characteristics related to ideas, procedures, and mathematical practices different from those studied in the academy⁵ (Rosa & Orey, 2013). They are professionals who accomplish the objectives and goals of the organizations such as schools and are crucial to the success of change efforts. Similarly, Fielding, Hogg, and Annandale (2006) affirm that positive deviants are exceptional and high achieving individuals who exceed normal or average levels of performance in a group. These individuals are “extremely resourceful, knowledgeable, and adaptable” (Clancy, 2010, p. 54).

This above discussion demonstrates that there is a need for educators to break the greater Western-Eurocentric perspective of what consists as mathematical knowledge. Hence, mathematical knowledge must be interpreted in the broader sense given that the term ethno is associated with members of identifiable cultural groups, such as national and tribal societies, working groups, children of a given age, individuals belonging to distinct professional classes, and marginalized and minority cultural groups (D’Ambrosio, 1985).

According to Rosa and Orey (2019a), this approach may assist this ongoing reconstruction process, which seeks to relate academic mathematics with sociocultural activities through the use of:

- Artifacts as observational objects created and developed by the members of distinct cultural groups. These instruments provide clues and information about its creators and users.
- Mentifacts as analytical tools such as thoughts, reflections, concepts and theories that represent the ideas and beliefs of the members of a particular cultural group, for example, religion, language, and laws.
- Sociofacts that represent the social structure of distinct cultural groups such as family and tribal structures. They can be considered as the patterns of interpersonal relations expected and accepted among the members of these groups.

This perspective aims to reduce prejudice, inequity, and harm due to ongoing disconnections between knowledge as practiced in the academy (etic) and its practical use in everyday life (i.e., emic). Positive deviance in mathematics curriculum and teaching can be seen as a responsible form of subversion that uses the theoretical and methodological apparatus of these investigations to reveal and combat the privilege and the authority that was granted to the academic mathematical discourse (Rosa & Orey, 2017).

This approach enables understanding and comprehension of how privilege and authority, stemming from colonization, have influenced the distribution of power in modern society (Fitzsimons, 2003). This context allows for the analogous use of positive deviance to conduct research in ethnomathematics in order to start a changing process in mathematics education by applying its pedagogical action. In this context, ethnomathematics helps students from distinct cultural groups to equally access academic mathematical discourse. This action also enables the identification of cultural traits⁶ that are not frequently recognized by educational institutions as features of students’ culture.

⁵Both approaches are good and, like learning languages, being *bimathematical* is good as well.

⁶Cultural traits can be considered as socially learned systems of beliefs, values, traditions, symbols, and meanings that members of a specific cultural group acquire throughout history. It is a deposit of knowledge, experiences, actions, attitudes, hierarchies, religion, notions of time, roles, spatial relations, concepts of the universe, and artifacts developed by the members of distinct cultural groups in the course of generations through individual and group strivings (Samovar & Porter, 2000).

For example, Rosa and Orey (2007) affirm that ethnomathematics investigates ways in which members of distinct cultural groups understand, articulate, and use ideas, notions, procedures, and concepts that can be identified as mathematical practices for the development of curricular activities. In this cultural dynamism, students are able to identify and decode the produced, transmitted, and accumulated local mathematical knowledge by having contact with academic mathematics in order to establish relationships and comparisons between these kinds of knowledge.

Therefore, the positive deviance aspects of ethnomathematics recognizes the specificities of the members of distinct cultural groups by emphasizing their mathematical knowledge systems, showing them in a dynamic way, and valuing them on their own terms and contexts. In this context, Lloyd (2011) states that it is important that researchers, teachers, and educators describe the ideas and procedures that are implicit in mathematical practices locally developed by the members of these groups. In this sense, the research of these practices can be regarded as a position of resistance towards the imposition of academic mathematical knowledge as they may suggest actions in search of creative and innovative solutions to these challenges.

Aspects of Positive Deviance in Ethnomathematics

Researchers in ethnomathematics have revealed cultural influences in the evolution of mathematical knowledge through the study of historical accounts. For example, Orey (2000) argues that this approach helps the analyses of mathematical ideas, procedures, and practices developed locally, which aims to deconstruct dominant mathematical discourse by offering innovative views about the nature of this knowledge.

This context enables positive deviance to be developed because the norms and rules applied in academic mathematics are often found to be inconsistent with the mathematical knowledge developed in terms of the local realities, customs and needs. For example, Rosa and Orey (2015) emphasize that investigations in both mathematics education and mathematics have often ignored connections between academic mathematical knowledge and the practices developed locally by members of distinct cultural groups.

In order to reduce the gap between theoretical and practical mathematical knowledge, there is a need for both researchers and educators to query about possible connections found between mathematical practices developed in particular cultural contexts. The positive deviance feature of ethnomathematics recognizes both the uniqueness and diverse perspectives of members of distinct cultural groups by giving voice to, and emphasizing emic knowledge systems (Rosa & Orey, 2019b).

Ongoing investigations in ethnomathematics must describe the ideas and procedures implicit in locally developed mathematical practices. In this regard, Lloyd (2011) as they may suggest actions in search of creative and innovative solutions to these challenges, it affirms that research on these practices can be regarded as a form of resistance towards imposition of academic mathematical knowledge. In this regard, Rosa and Orey (2015) affirm that what is important are the results of these investigations that show that mathematical knowledge developed locally is worthy of recognition and appreciation by the members of the academic community.

For example, Pinheiro (2017) proposed an innovative ethnomathematics pedagogical action in the teaching and learning mathematics by deaf students. The methodology adopted in his study was related to the contextualization of everyday phenomena through which it was possible to negotiate meaning, thus, favouring the construction of mathematical and financial concepts of deaf students.

Positive deviance in the pedagogical action of ethnomathematics as well as in its research paradigm refers to behavioural, cultural, political, economic, environmental, and social changes premised on the observation that when members of distinct cultural groups confront similar challenges they employ uncommon, yet successful mathematical ideas, procedures, and strategies that enable them to find solutions to the problems they face in their own communities (Rosa and Orey 2017).

According to D'Ambrosio (2011), members of distinct cultural groups, in their search for transcendence and survival, develop explanations for problems they face, as well they collect information that makes for the creation of their own myths and mysteries, which help them to explain their sociocultural and natural environments by developing cultural artefacts. Material representations of reality (artifacts) organized in the form of language, art, and techniques are both observable and can be interpreted by the members of other cultural groups. In this process, codes, symbols, and representations are created by the development of mental representations that are shared by the members of distinct cultural groups through the use diverse artefacts that help them to constitute their own cultures.

Mathematical artefacts are first generated by the members of distinct cultural groups who interact with natural, social, economic, political, and sociocultural environments in order to resolve situations and problems, and to explain and understand mathematical facts and phenomena that occur in their day to day life (D'Ambrosio, 2011). Both artifacts and mentifacts are organized, transmitted, diffused, and shared with the members of other cultural groups.

For example, the results of ethnomathematics study conducted by Cortes (2017) shows that farmer vendors have their own artefacts such as manual scales and different packing of products that they develop their own mental calculations and distinct ways of determining the price, and diverse procedures to weigh their own products. One of the main results of his study was to provide innovative and integrative approaches to mathematics curricula that consider the origins of both local and academic mathematical knowledge through the development of ethnomodels⁷.

Consequently, Rosa and Orey (2017) emphasize the importance of communities for schools, as it seeks to connect academic practices to mathematical knowledge developed locally. It is also necessary that the development of school curricula is designed to promote the valorisation of local knowledge and practices developed by the members of distinct cultural groups who integrate school contexts. This kind of positive deviance aims to reduce prejudice, inequity, and harm due to disconnections between mathematical knowledge as practiced in the academy and its practical use in everyday life.

This perspective provides a necessary balance to school curricula since it integrates cultural components in the process of teaching and learning mathematics. This approach aims at the humanization of mathematics through contextualized activities in ongoing mathematics curriculum development. This is one of the most important positive deviance features in the pedagogical action of ethnomathematics in schools. Consequently, the "teacher is challenged to introduce the cultural diversity of pupil's mathematical practices in the curriculum since pupils also use mathematical practices in their everyday life" (François, 2010, p. 1518).

According to Rosa and Orey (2017), this context allows for the analogous use of positive deviance to conduct research in ethnomathematics in order to start a changing process in mathematics education. However, it is necessary that professionals are willing to take the risks associated with that decision. This decision-making process is one of the most important components of positive deviance, which can be understood as a fight against

⁷Ethnomodels can be considered as small units of information rooted in sociocultural contexts, which are representations of reality that help members of distinct cultural groups to interpret and understand phenomena they face daily (Rosa & Orey, 2019a).

dehumanizing effects of bureaucratic authority that may occur during the conceptions of investigations related to the ethnomathematics program.

According to Rosa and Orey (2019b), this conception of an alternative mathematics curriculum design is related to the access to the information of dominant mathematical discourses, which may provide critical reflections regarding to the application of the mathematics curriculum. In this context, the study of mathematical practices developed by members of distinct cultural groups can be considered as a resistance position of creative insubordination because such practices become innovative pedagogical trends for teaching and learning mathematics.

In this context, ethnomathematics emphasizes the importance of community to school because it seeks to connect school mathematics to the practices developed locally. So, it is necessary that the school curriculum is designed to value and promote local knowledge and practices developed by the members of the communities that integrate school context. This perspective also provides the necessary balance to the school curriculum because the integration of these components in the mathematics curriculum enables the conception of Ethnomathematics as a program that aims at the humanization of mathematics through contextualized approach to the curriculum.

This particular curriculum exercise can be also considered as a resistance positioning because by using the data gathered from this study, educators are able to soften institutionalized teaching practices through the context of everyday activities by applying mathematical activities based on the ethnomathematics program. In this regard, Rosa and Orey (2007) stated ethnomathematics enables the development of teaching strategies that help educators to make methodological decisions related to their teaching practices in order to improve mathematics performance of their students. Thus, these professionals modify, adapt, and soften curriculum policies they believe are unfairly foisted to the members of the school communities.

Final Considerations

Mathematical thinking is developed and used in distinct sociocultural contexts with specific needs and ways of life. Thus, it is important to analyse the relation between culture and mathematics by questioning the predominant view that mainstream mathematics is culture-neutral. However, it is also necessary that both researchers and educators are willing to, indeed, be supported in, taking risks associated with the decision of using local mathematical knowledge in the mathematics curriculum.

This decision-making process is one of the most important components of positive deviance. Thus, this approach can be understood as a fight against the dehumanizing effects of bureaucratic authority that occurs during the conduction of research and investigations related to ethnomathematics as a program (Rosa & Orey 2017). There is no doubt on the importance of modern science and mathematics, yet, westernized mathematical knowledge has come to be primarily dominated by the capitalistic and often destructive preferences from European and North American science and its accompanying Eurocentrism.

This domination process poses many problems in mathematics education in non-Western and/or non-dominant cultures. In this context, it is necessary to recognize that D'Ambrosio (2006) stated that conceptions of mathematical practices have been imposed globally through the imposition of series of colonial intrusions as the pattern of rational human behaviour. By developing systematic studies by using ethnomathematics, it is possible to comprehend new contexts and perhaps skills that allow us to observe mathematical phenomena on more inclusive and broader wavelength.

The results may then lead us to new viewpoints in mathematics education in order and to improve cultural sensitivity in teaching practices. In this regard, we see ethnomathematics as the study of mathematical phenomena within a culture, and it differs from the traditional conception that considers it as the foundations of one kind of mathematics that is constant and applicable to everyone and everywhere. Mathematics then becomes a social construct because it is culturally bound.

This article discussed concepts of positive deviance from the perspective of ethnomathematics. This specific form of pedagogical action helps students to overcome the use of disassociated techniques and formulas often blindly memorized. As well, it allows them to develop strategies and techniques in order to give access to diverse mathematical representations in a new formative dimension of the mathematical nature. These pedagogical practices transcend physical environments in order to welcome knowledge and procedures developed in the diverse sociocultural contexts of students (Rosa & Orey, 2015).

In this approach, one important pedagogical action for the development of mathematics is related to the transformation of mathematics into a living knowledge that integrates real situations through questionings, analysis, and critical reflection of phenomena that occur in everyday life of the students. It is in the school community itself that researchers and educators can easily find didactic elements of mathematical content necessary in the development of mathematics curriculum (D'Ambrosio, 2006).

Positive deviance, especially in regard to an ethnomathematics program, can be considered as a tool to combat the dehumanizing effects of curricular and bureaucratic authority by decolonizing mathematical ideas, procedures, and practices in a search for peace. Thus, Rosa and Orey (2017) argue that the objective of this deviance is to ensure that curricular bureaucracies do not disservice students when public policies and institutional procedures have no real connections with the school communities.

Hence, there is a need to diversify teaching strategies used in the classrooms such as the use because there is no single recipe for improving the performance of students in mathematics. Thus, teachers need to be committed to innovative educational pedagogy in order to help students to reach their educational potential. This type of positive deviance can be considered as combat against the dehumanizing effects of curricular bureaucratic authority.

Of course, there is no single recipe for improving students' performance in mathematics. At the same time, educators and researchers need to be supported as they develop ethnomathematics through ethnomathematics that can allow them to implement innovative pedagogies that can help students to reach their sociocultural and academic potential, through a diversity of teaching strategies used in the mathematics curriculum, such as the use of ethnomathematics.

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