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Responsible Subversion and the Importance of Local (Emic) Knowledge in Ethnomathematics

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Abstract

A current dilemma in the conduction of investigations in mathematics education is related to its frequent acknowledgment of global (etic) mathematical knowledge. Thus, there is a gap in the use of local (emic) mathematical knowledge in the problem statements proposed for conducting research regarding this theme, which do not consider relevant the development of local procedures, techniques, and practices in its research theoretical basis. In this context, ethnomathematics is a form of push back from colonization without attempting to replace school/academic mathematics, yet it considers making the school/academic norms and rules more flexible to address local mathematical ideas, procedures, and practices. Hence, a sense of subversion triggered by ethnomathematics is responsible and often evokes an impression of disturbance that causes a conscious review of endemic rules and regulations to many curricular and educational contexts. This process enables educators and investigators to adopt responsible subversion in developing pedagogical actions that deal with content usually disconnected from the reality of the students, which enables them to deal with imposed school/academic norms and rules. Thus, this theoretical article shows that responsible subversions involve an intentional act of bending the rules to serve the greater good of the members of the school/academic communities.

Keywords: Ethnomathematical Approaches, Ethnomathematics Program, Local (Emic) Knowledge, Pedagogical Action, Responsible Subversion.

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Initial Considerations

Ethnomathematics as a research program arose in opposition to the dominant and Eurocentric discourse in mathematics education, which is emphasized in school curricula developed and used by formerly colonized countries and imposed on local communities during the same process of colonization. This context allowed the emergence of ethnomathematics as a research program that fights Eurocentric discourse imposed by the colonial powers in the conquest process of their colonies in distinct parts of the world. In this context, there is a need to challenge the view that members of local and distinct cultural groups only develop simplistic and folkloristic techniques for solving problems they face daily.

Thus, the emergence of an ethnomathematics program can be interpreted to some extent as a reaction to cultural imperialism, which spread around the world with the expansion of great navigations from the fifteenth century (D'Ambrosio, 1985). This reaction can be connected to the concept of responsible subversion (Hutchinson, 1990) as it relates to the flexibility of rules and regulations to achieve the welfare of members of distinct cultural groups.

In the field of education, according to D'Ambrosio and Lopes (2015), the concept of subversion refers to teachers, professors, educators, administrators, and researcher practices that, in an insubordinate way, but with discernment, are opposed to educational proposals with no pedagogical sense, of educational bureaucracy and of the public policy. This concept also refers to actions that are assumed in relation to the norms and institutional rules, which aim at a better commitment to the needs of the diverse school population.

Many professionals are considered responsible subversives when they create creative alternatives pedagogical actions to achieve better results for the common good of the school community, which are constituted by their colleagues, students, parents, and diverse members of this community. This action is an opposition and, generally, a challenge to the authority established when it opposes the good of the others, even if it is unintentional excluding and/or discriminatory policies (Rosa & Orey, 2015).

Responsible subversion refers to methods that empower members of distinct cultural groups to gain awareness about when, how, and why to act against established procedures or guidelines that are unjust and/or do not positively serve their population. Being subversively responsible requires assuming oneself as an unfinished being that takes curiosity as the foundation of the production of knowledge and makes it unfinished and a permanent search movement (D'Ambrosio & Lopes, 2015).

According to this context, ethnomathematics can be considered a subversive and responsive program when causes disruption of the existing order in the school/academic mathematics by encouraging and developing the study of local ideas, procedures and mathematical practices found in various, specific, and diverse cultural contexts, which are in accordance with the emic (local) perceptions of its members (Rosa & Orey, 2016a). In this regard, this program has broken the rules and bureaucratic expectations of school/academic mathematics in order to recognize divergent ways and value the diverse modes in which mathematical knowledge is produced in other cultural contexts.

The subversion triggered by this program is deemed responsible because it initiated a disturbance that caused a review of the traditional or western, academic mathematical knowledge system by increasing the potential for growth and the emergence of new opportunities for the discussion of the nature of the mathematics curriculum and its role in a glocalized society1. In accordance with Rosa and Orey (2015), responsible subversion contributes to the confrontation of antiquated and outmoded taboos related to ideas suggesting that mathematics is a universal field of study without traditions and cultural roots.

[1]According to Rosa and Orey (2016b), a glocalized society enables the development of active, interactional, and dialogical processes that requires an ongoing negotiation between the local (emic) and the global (etic) mathematical, scientific, technological, and engineering knowledge through the development of a cultural dynamism, which is known as glocalization.

Three Cultural/Anthropological Ethnomathematical Approaches

The challenge researchers have in dealing with issues related to the sociocultural aspects of mathematics is to develop solid methodological procedures that can help us to understand culturally bound mathematical ideas, procedures, and practices developed by members of distinct cultural groups without letting their culture interfere with the cultural background of these members. In this regard, many members of distinct cultural groups developed interpretations of their own local culture (emic approach) opposed to the outsiders' view or global interpretation (etic approach) (Orey & Rosa, 2014).

It is necessary to review notions that mathematical ideas, procedures, and practices are uniquely modern or European in origin. This notion is often confused as they are based on certain philosophical assumptions and values that are strongly endorsed by western civilizations and are confused with the enormous wealth and power of the colonizers themselves. On the one side are beliefs that mathematical procedures are unique, and that the sociocultural unit of operation is the individual; on the other side are beliefs that mathematical practices are the same and that its goals and techniques are equally applicable across all cultural groups.

An important goal is to challenge and strengthen existing theoretical models. This makes sense when we consider both the assumptions of mathematical universality and the claims of descriptive, predictive, and explanatory adequacy. A second goal is to understand and explain both existing and historical variations of mathematical ideas, procedures, and practices that vary across time, culture of origin, race, ethnicity, gender, and other sociocultural characteristics.

Therefore, when working with ethnomathematics, it is possible to identify three approaches that help us to investigate, study, and understand the mathematical ideas, procedures, and practices developed by the members of any given cultural group:

1. *Global* (etic-outsider) is the outsiders' view on beliefs, customs, and scientific and mathematical knowledge of the members of distinct cultural groups. Globalization has reinforced the utilitarian approach to school mathematics and the Western bias prevailing in mathematics curricula, as well as helped to globalize pervasive mathematical ideologies that functions as a filter to select students to advance in their life professionally and academically. In particular, school mathematics is criticized as a cultural homogenizing force, a critical filter for status, a perpetuator of mistaken illusions of certainty, and an instrument of power. The mathematics curriculum is central to cultivating values as well as fostering the conscientization of learners. In this approach, comparativist researchers attempt to describe differences and similarities among cultures. According to Sue and Sue (2003), these individuals are known as culturally universal. For Dossey

(1992), these individuals are considered as externalists because they believe that mathematical activities are culture free.

2. *Local* (emic-insider) is the insiders' view on their own culture, customs, beliefs, and scientific and mathematical knowledge. Local knowledge is important because it has been tested and validated within the local context. Local knowledge creates a framework from which members of distinct cultural groups can understand and interpret the world around them. Currently, there is a recognition of the importance of local contributions to the development of scientific and mathematical knowledge. In this approach, the members of distinct cultural groups describe their culture in its own terms. According to Sue and Sue (2003), these individuals are culturally specific. For Dossey (1992) and D'Ambrosio (1990), these individuals are considered internalizes because they acknowledge that mathematics is a cultural product, which is a result of the development of distinct local activities such as counting, locating, measuring, designing, playing, inferring, and modelling.
3. *Glocalization* (emic-etic/cultural dynamism) represents a continuous interaction between globalization and localization, which offers a perspective that both approaches are important components of the same phenomenon (Kloos, 2000). It involves blending, mixing, and adapting two processes in which one component must address the local culture, system of values and practices (Khondker, 2004). In a glocalized society, members of distinct cultural groups must be "empowered to act globally in its local environment" (D'Ambrosio, 2006, p. 76) and vice-versa. In this context, it is "necessary to work with different cultural environments and, acting as ethnographers, to describe mathematical ideas and practices of other peoples. It is fundamental to give meaning to these findings" (D'Ambrosio, 2006, p. 79). It is important to highlight that the concept of glocalization follows a sociological/historical approach regarding society and its dynamic social transformations (Khondker, 2004).

Through focusing on local knowledge first and then integrating global influences may develop individuals and collective groups who are rooted in local cultural traditions and contexts but are also equipped with a global knowledge, which creates a sort of localized globalization (Cheng, 2005). In accordance with this context, Rosa and Orey (2018) emphasize that glocalization is an:

(…) approach that forms an expression and dialogical relationships between local and global mathematical practices and knowledge traditions. This dialogue provides the development of glocal mathematical knowledge, which has the potential to generate empowering synergies between localization and globalization, even new forms of thinking and doing mathematics. In this process, it is

necessary to conceive ways used to articulate mathematical knowledge in more inclusive and synergistic modes (p. 186).

According to this context, it is imperative to ask: Should researchers agree with the imposed cultural universality (global) of mathematical knowledge or take on techniques, procedures, and practices of its cultural relativism? In this perspective, it is important to discuss how some researchers are still seeking to link universal (global) and community specific (local) approaches and how they face the classic dilemma of scientific and conflicting goals related to conduct investigations in ethnomathematics.

Both local and global approaches are often perceived and seen as incommensurable paradigms. While they are thought of as creating a conflicting dichotomy, instead, we believe that they can be considered as complementary viewpoints, rather than posing a dilemma because the use of both approaches deepens our understanding of important issues in scientific research and investigations about ethnomathematics (Rosa & Orey, 2013). Since these two approaches are complementary, it is possible to delineate forms of synergy between the local and global aspects of mathematical knowledge in order to flexibilize imposed school mathematics curriculum norms (Rosa & Orey, 2021).

A suggestion for dealing with this dilemma is to use a combined local-global approach, rather than simply applying local or global dimensions of one culture to other cultural groups. A combined local-global approach requires researchers to first attain local knowledge developed by the members of distinct cultural groups. This approach allows us to become familiar with the relevant cultural differences in diverse sociocultural settings (Rosa & Orey, 2015).

Similarly, the resurgence of debates regarding cultural diversity in the mathematics curriculum has also renewed the classic global-local debate since we need to comprehend how build and connect many scientific generalizations while trying to understand and make use of their own sociocultural perspectives, traditions, and diversities. Yet, attending to unique mathematical interpretations developed in each cultural group, often challenges fundamental goals of mathematics in which the main objective is to build theories that describe the development of mathematical practices in academia are found.

Local (emic) observations seek to understand culture from the perspective of internal dynamics and relationships as influenced within a culture. A global approach often makes use of, or becomes a cross-cultural contrast or comparative perspective, and which seeks to comprehend or explain different cultures from the outside worldview (Orey & Rosa, 2021). Hence, local worldviews often clarify intrinsic cultural distinctions while the global worldview seeks objectivity of the outside observers across cultures (Anderson, 2007).

This local approach seeks to examine the native principles of classification and conceptualization from within each cultural system. The important distinctions made by members of a particular culture are emphasized. Hence, a local analysis is culturally specific in the context of the insider's beliefs, thoughts, and attitudes. Local knowledge and interpretations are essential to any emic analysis. It is from the viewpoint of the participant that messages about cognitive and behavioral dimensions for the understanding of cultural context are shared and will be conveyed. Therefore, "what is emphasized in this approach is human self-determination and self-reflection" (Helfrich, 1999, p. 133).

A global analysis possesses a cross-cultural approach. In this context, etic-oriented researchers examine the question of a cross-cultural perception so that their observations are taken according to externally derived criteria. This context allows for the comparison of multiple cultures where "both the objects and the standards of comparison must be equivalent across cultures" (Helfrich, 1999, p. 132).

Accordingly, in the conduction of ethnomathematics research, cultural, social, linguistic, political, religious, and ethnic affiliations are examined and respected, and research integrates these diverse points of view into a unified holistic solution. In this manner, the intended mathematical practice is given a stake in the overall process and not just the mere ending result.

Aspects of Responsible Subversion in the Ethnomathematics Program

Much of the important research and investigations in ethnomathematics have revealed the cultural influences 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 aimed to deconstruct dominant mathematical discourse by offering innovative views about the nature of this knowledge (Ascher, 2002; Orey, 2000). In this regard, responsible subversion evolved in this process as the norms and rules applied in school/academic mathematics were seen as inconsistent with the advanced mathematical knowledge advanced developed in terms of the local realities.

There are many criticisms directed towards investigation in mathematics education that ignore connections between mathematical school/academic knowledge and the practices developed by members of distinct cultural groups in their own contexts (Rosa & Orey, 2021). Consequently, in order to reduce the gap between theoretical and the practical mathematical knowledge, there is a need for researchers to query possible connections between the mathematical knowledge developed in a particular cultural context and that practiced and supported by the school/academy.

It is also important that the results of this work, research and investigations show that mathematical knowledge developed locally is worthy of recognition and appreciation by the members of

the academic community as well (Rosa, 2010). It may not engender great economic, political, or military power, but it has often sustained populations for millennia, and is due both study and deep respect. At the very least, it should be documented before it disappears. For this reason, Rosa and Orey (2015) comment about the importance of the results of investigations that show that mathematical knowledge developed locally must be acknowledge, valued, appreciated, and respected by the members of the school/academic communities.

In this context, the results of the study conducted by Pinheiro (2017) show that the importance of the proposition of innovative ethnomathematics pedagogical actions in the processes of teaching and learning mathematics for deaf students. The methodological procedures adopted in his study were related to the contextualization of everyday phenomena in an ethnomathematical perspective through which it was possible to negotiate meanings, thus, favoring the construction of mathematical and financial concepts by deaf students.

A responsible subversive ethnomathematics program recognizes the uniqueness and the perspectives of members of distinct cultural groups by emphasizing their emic mathematical knowledge systems, showing them in a dynamic way, and valuing them on their own terms and contexts (Rosa & Orey, 2016a). It is important that ongoing research and investigation in ethnomathematics allows people from outside the academic context to describe their ideas and procedures implicit in mathematical practices locally developed by the members of their own group.

In this context, the results of the study conducted by Cortes (2017) showed that farmer vendors develop their own artifacts to measure and pack their fruit and vegetable products, such as manual scales. They also develop different ways to pack these products by using 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 school/academic mathematical knowledge through the development of ethnomodels (Cortes, 2017). According to Rosa and Orey (2019), ethnomodels are considered as small units of information rooted in sociocultural contexts that are representations of reality that help members of distinct cultural groups to understand and interpret phenomena they face daily.

In this regard, investigations conducted on these practices can be regarded as forms of resistance towards the imposition of school/academic mathematical knowledge as they may suggest actions in search of creative and innovative solutions to these challenges (Lloyd, 2011). For example, a study conducted in Brazil by 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 obtained from this research showed that mathematical knowledge produced, developed, and transmitted in construction sites had important curricular implications that were inferred from this kind of knowledge production. It also studied the connections of the local knowledge with academic knowledge legitimized by the school in order to determine curricular modifications (Duarte, 2004). The researchers found that these connections had positive results in the development of a mathematics curriculum in schools.

A responsible subversive ethnomathematics program can contribute to the generation of new mathematical knowledge and assist in resolving ethical dilemmas involved in research and investigations in this area of study. During investigations seeking to understand and comprehend local mathematical knowledge, researchers may be faced with a set of specific characteristics related to ideas, procedures, and mathematical practices that are different from those studied in the school/academy (Rosa & Orey, 2012).

Hence, mathematical knowledge must be interpreted in a 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).

For example, Mesquita (2020) conducted her study in a public state school, located in a peripheral community in the metropolitan region of Belo Horizonte, Minas Gerais. In this study, she collected data originated with for the study originated from 6 (six) students in the eighth grade of middle school and with a collector of recycled materials. Its main objective was related to conducting a sociocritical analysis of ethnomodelling as a pedagogical action in the development of mathematical content in a peripheral community.

The results of this study showed how ethnomathematics contributed to the development of mathematical content of the students, who are residents of a peripheral community, which enabled them to discuss the lack of adequate basic sanitation that make up the daily lives of its members. These results also show that ethnomathematics provided students with the development of a critical reflection in relation to their space itself.

This above discussion shows that there is a need for researchers to break the greater western-Eurocentric perspective of the development of mathematical knowledge through history (Anderson, 1997). This approach enables researchers to assist this ongoing reconstruction process, which seeks to relate school/academic mathematics with sociocultural activities with:

1. *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 (D'Ambrosio, 2006).
2. *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 (D'Ambrosio, 2006).
3. *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 (D'Ambrosio, 2006).

It is important to highlight that this perspective aims to reduce the prejudice, inequity, and harm due to the greater disconnection between mathematical knowledge as practiced in the academy (etic) and its practical use in everyday life (emic) (Rosa & Orey, 2016a). This means that responsible subversion by research in ethnomathematics 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, 2021).

This approach enables the understanding and comprehension of how privilege and authority, stemming from colonization, have influenced the distribution of power in modern society (Fitzsimons, 2003), which is related to power relation that was imposed to the entire world in the colonization process (Rosa, 2010). This context allows the analogous use of responsible subversion conceptualization to conduct research in ethnomathematics in order to start a changing process in the development of mathematics education. However, it is necessary that professionals who deal with education are willing to take the risks associated with that decision (Rosa & Orey, 2015).

It is necessary to emphasize that this decision-making process is one of the most important components of responsible subversion, which can be understood as a fight against dehumanizing effects of bureaucratic authority (Haynes & Licata, 1995) that may occur during the conductions of researches and investigations related to the ethnomathematics program.

Final Considerations

This article briefly outlines, indeed offers an introduction to ongoing research related to cultural perspectives in ethnomathematics. Chiefly, this work acknowledges how contemporary academic mathematics is predominantly Eurocentric. Eurocentrism has its positive elements in relation to dramatic

scientific accomplishments over the last 500 years. Yet, at the same time, it has hindered local (emic) mathematics ideas, specifically those once practiced by vanquished societies.

Many procedures and practices coming from local traditions, which are the emic (local) perceptions developed by the members of distinct cultural groups, have been lost, many are considered inferior, simplistic, folkloristic, and therefore, unimportant, unvalued, and disrespected by the dominant society.

Moreover, westernized mathematics as primarily dominated by the preferences of the West (European-North American) and accompanying Eurocentrism poses many problems in mathematics education in non-Western or non-dominant cultures. For example, concepts and conceptions of mathematics have been imposed globally, through a series of colonial intrusions, as the pattern of rational human behavior (D'Ambrosio, 2006).

A systematic ethnomathematics study aims at developing skills to observe mathematical phenomena rooted in distinct cultural settings. The results may then lead to new viewpoints into mathematics education in order to improve cultural sensitivity in teaching mathematics. In this regard, ethnomathematics is defined as the study of mathematical phenomena within a culture, thus, it differs from the traditional conception that considers it as the foundations of mathematics education as constant procedures and applicable everywhere. Therefore, in the ethnomathematics process, mathematics is a social construction and is often culturally bound.

This article also showed the concepts of responsible subversion applied in the ethnomathematics program. The pedagogical action of this program helps students to overcome the use of disassociated techniques and formulas often blindly memorized. As well, it allows them to develop strategies in order to give access to diverse mathematical representations in a new formative dimension of mathematical nature.

For example, the main objective of the qualitative study conducted by Ruggiero (2020) was to assist members of distinct cultural groups (coffee workers and students) in developing pedagogical actions in classroom related to both emic (local) and etic (global) mathematical knowledge through a dialogical approach (glocal).

The results of this study enabled students to value, respect, and appreciate mathematical knowledge developed by the members of distinct cultural groups (coffee and school cultures) through cultural dynamism. In this regard, emic (local) mathematical knowledge was used holistically for the development and formulation of etic (global) curricular mathematical activities, in a dialogical manner, which enabled the understanding of mathematical processes developed by members inserted in the coffee culture.

The ethnomathematics program emphasizes the importance of community to school because it seeks to connect school mathematics to practices developed locally. It is necessary that the school curriculum is designed to value and promote local knowledge (emic) and practices developed by members of communities who integrate school contexts. Thus, this perspective provides a necessary balance to 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 approaches to curriculum development.

It is important to emphasize that pedagogical actions in the context of an ethnomathematics program allows for a more comprehensive analysis of the school context because many pedagogical practices transcend physical environments in order to welcome knowledge and practices present in diverse sociocultural contexts of students (Rosa & Orey, 2015). In this approach, one important pedagogical proposal by the school curriculum could be to transform mathematics into a living knowledge that integrates real situations through questionings, analysis, and critical reflection of phenomena that occur in everyday life.

For example, Haynes and Licata (1995) argue that the objective of this responsible subversion is to ensure that curricular bureaucracies do not disservice students because, often, public policies and institutional procedures have no real connections with the activities developed daily by the member of the school community.

Thus, it is in the school community itself that researchers, investigators, and educators may find the didactic elements of the mathematical content necessary in the development of mathematics curriculum (D'Ambrosio, 2006). Therefore, there is a need to diversify teaching strategies used in the mathematics curriculum, such as the use of ethnomathematics.

It must be acknowledged here that there is no single recipe for improving the performance of students in mathematics. In this sense, teachers need to be supported, and educational leaders need to be committed to innovative educational pedagogies in order to engage their students in a more meaningful mathematics. Responsible subversion, especially regarding ethnomathematics, can be considered as a tool to combat against dehumanizing effects of curricular bureaucratic authority.

In this context, D'Ambrosio (2017) states that this insubordinate but responsible approach through the development of ethnomathematics is a tool for peace in its several dimensions: inner peace, social peace, environmental peace, and military peace, which leads humanity towards total peace. Thus, ethnomathematics favors solidarity, collaboration, and cooperation among members of distinct cultural groups by considering that it values and respect the development of local mathematical ideas, procedures, techniques, and practices, which is associated with the pursuit of total peace in order to

build up a civilization free of truculence, arrogance, intolerance, discrimination, inequity, bigotry, and hatred.

References

Ascher, M. (2002). *Mathematics elsewhere*: an exploration of ideas across cultures. Princeton, NJ: Princeton University Press.

Anderson, S. E. (1997). Worldmath curriculum: fighting Eurocentrism in mathematics. Powell, A. B., & Frankenstein. (Eds.), *Ethnomathematics*: challenging Eurocentrism in mathematics education (pp. 291-306). Albany, NY: SUNNY.

Anderson, D. (2007). Multicultural group work: a force for developing and healing. *The Journal for Specialists in Group Work*, *32*(3), 224–244.

Cheng, Y. C. (2005). *New paradigm for re-engineering education*. New York, NY: Springer.

Cortes, D. P. O. (2017). *Re-significando os conceitos de função*: um estudo misto para entender as contribuições da abordagem dialógica da etnomodelagem [Re-signifying function concepts: a mixed methods study to understand the contributions of dialogic approach of ethnomathematics]. Dissertação de mestrado. Departamento de Educação Matemática. Ouro Preto, MG: UFOP.

D'Ambrosio, U. (1985). Ethnomathematics and its place in the history and pedagogy of mathematics. *For the Learning of Mathematics*, 5(1)1, 44-48.

D'Ambrosio. U. (2006). The program ethnomathematics and the challenges of globalization. Circum*scribere: International Journal for the History of Science*, *1*, 74-82.

D'Ambrosio, B. S., & Lopes, C. E. (2015). *Creative insubordination in Brazilian mathematics education research*. Raleigh, NC: Lulu Press.

Dossey, J. A. (1992). The nature of mathematics: its role and its influence. In: D. A. Grouws (Ed.). *Handbook of research on mathematics teaching and learning*: a project of the national council of teachers of mathematics (pp. 39-48). New York, NY: Macmillan.

Duarte, C. G. (2004). Implicações curriculares a partir de um olhar sobre o mundo da construção civil [Curricular implications related to the of world civil construction]. In: Knijnik, G., Wanderer, F. & Oliveira, C. J. (Eds.). *Etnomatemática*: currículo e formação de professores [Ethnomathematics: curriculum and teacher education] (pp. 195-215). Santa Cruz do Sul, RS, Brazil: EDUNISC.

Fitzsimons, G. A. (2003). What counts as mathematics? Technologies of power in adult and vocational education. *ZDM*, *35*(6), 323-324.

Haynes, E. A., & Licata, J. W. (1995). Creative insubordination of school principals and the legitimacy of the justifiable. *Journal of Educational Administration*, *33*(4), 21-35.

Helfrich, H. (1999). Beyond the dilemma of cross-cultural psychology: Resolving the tension between etic and emic approaches. *Culture and Psychology*, *5*, 131–153.

Hutchinson, S. A. (1990). Responsible subversion: a study of rule-bending among nurses. *Scholarly Inquiry for Nursing Practice, 4*(1), 1-3.

Khondker, H. H. (2004). Glocalization as globalization: evolution of a sociological concept. *Bangladesh e-Journal of Sociology*, *1*(2), 1-9.

Kloos, P. (2000). The dialectics of globalization and localization. In: D. Kalb, M. van der Land, R. Staring, B. van Steenbergen & N. Wilterdink (Eds.), *The ends of globalization: bringing society back in* (pp. 281-298). Lanham, MD: Rowman & Littlefield.

Lloyd, J. C. (2011). For clues to HAI prevention, seek out positive deviance. *Healthcare Purchasing News*, *35*(1), 46-47.

Mesquita, A. P. S. S. (2020). *Uma ação pedagógica para o desenvolvimento de conteúdos matemáticos em uma comunidade periférica* [A pedagogical action for the development of mathematical content in a peripheral community]. Dissertação de Mestrado em Educação Matemática. Departamento de Educação Matemática. Ouro Preto, MG: Universidade Federal de Ouro Preto – UFOP.

Orey, D. C. (2000). The ethnomathematics of the Sioux tipi and cone. In: Selin, H. (Ed.), *Mathematics across culture*: the history of non-western mathematics (pp. 239-252). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Orey, D. C., & Rosa, M. (2014). How we came to use a combination of emic, etic, and dialogical approaches in the field research ethnomodeling. In: Manuel Murillo Tsijli. (Org.), *Memória IX Festival Internacional de Matemática* (pp. 167-179). Quepos, Costa Rica: CIENTEC.

Orey, D. C., & Rosa, M. (2021). Glocalization of cultural practices through ethnomodelling. In: Leung, F. K. S., Stillman, G. A., Kaiser, G., Wong, K. L. (Eds.), *Mathematical modelling education in east and west* (pp. 55-65). International Perspectives on the Teaching and Learning of Mathematical Modelling. Cham, Switzerland: Springer.

Pinheiro, R. C. (2017). *Contribuições do programa etnomatemática para o desenvolvimento da educação financeira de alunos Surdos que se comunicam em Libras* [Contributions of the ethnomathematics program to the development of financial education of Deaf students who communicate in the Brazilian sign language]. Dissertação de Mestrado. Departamento de Educação Matemática. Ouro Preto, MG: UFOP.

Rosa, M. (2010). *A mixed-methods study to understand the perceptions of high school leader about English language learners (ELL):* the case of mathematics. Doctorate dissertation. College of Education. Sacramento, CA: California State University, Sacramento - CSUS.

Rosa, M., & Orey, D. C. (2012). O campo de pesquisa em etnomodelagem: as abordagens êmica, ética e dialética [The research field in ethnomodeling: emic, etic, and dialectical approaches]. Educação e *Pesquisa*, *38*(4), 865-879.

Rosa, M., & Orey, D. C. (2013). Ethnomodeling as a research theoretical framework on ethnomathematics and mathematical modeling. Journal of Urban Mathematics Education, 6(2), 62-80.

Rosa, M., & Orey, D. C. (2015). Evidence of creative insubordination in the research of pedagogical action of ethnomathematics program. In D'Ambrosio, B. S.; & Lopes, C. E. (Orgs.), *Creative insubordination in Brazilian mathematics education research* (pp. 131-146). Raleigh, NC: Lulu Press.

Rosa, M., & Orey, D. C. (2016a). Ethnomodelling: exploring glocalization in the contexts of local (emic) and global (etic) knowledges. *International Journal for Research in Mathematics Education, 6(*1), 196-218.

Rosa, M., Orey, D. C. (2016b) Humanizing mathematics through ethnomodelling. *Journal of Humanistic Mathematics*, *6*(3), 3-22.

Rosa, M., Orey, D. C. (2018). Reflecting on glocalization in the contexts of local and global approaches through ethnomodelling. *Educação Matemática Pesquisa*, *20*(2), 171-201.

Rosa, M., & Orey, D. C. (2019). Ethnomathematics and the responsible subversion of its pedagogical action: an investigation based on three anthropological approaches. *Revista Brasileira de Estudos Pedagógicos*, *100*(254), 191-209.

Rosa, M., & Orey, D. C. (2021). Positive deviance in the pedagogical action of ethnomodelling. In: Leung, F. K. S., Stillman, G. A., Kaiser, G., Wong, K. L. (Eds.), *Mathematical modelling education in east and west* (pp. 67-77). International Perspectives on the Teaching and Learning of Mathematical Modelling. Cham, Switzerland: Springer.

Ruggiero, E. D. D. (2020). *Etnomodelagem e café: propondo uma ação pedagógica para a sala de aula* [Ethnomathematics and coffee: proposing a pedagogical action for classrooms]. Dissertação de Mestrado em Educação Matemática. Departamento de Educação Matemática. Ouro Preto, MG: Universidade Federal de Ouro Preto - UFOP.

Sue, D. W., & Sue, D. (2003). *Counseling the culturally diverse*: theory and practice. New York, NY: John Wiley & Sons.