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Philosophical concepts of creative insubordination in ethnomodeling research

Conceitos filosóficos de insubordinação criativa na pesquisa de etnomodelagem

Conceptos filosóficos de la insubordinación creativa en la investigación en etnomodelación

Concepts philosophiques de l'insubordination créative dans la recherche en ethnomodélisation

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Abstract

The application of modelling methods makes sense to researchers and educators when these professionals examine the mathematical patterns developed by members of distinct cultures. Currently, an important issue in mathematics education is its tendency towards valuing a local orientation in its research paradigm. Thus, a search for innovative methodologies such as ethnomodeling is necessary to record the historical forms of mathematical ideas, procedures, and practices developed in diverse cultural contexts. Yet, ethnomodeling is not an attempt to replace globalized school/academic mathematics, however, it is necessary to recognize the existence of local mathematical knowledge in the school curriculum. This context enabled the emergence of creative insubordination of ethnomodeling as it evoked a disturbance that caused a revision of the rules and regulations in the mathematical modelling process. This process triggered a debate about the nature of mathematics in relation to culture by proposing a dialogue between local and global approaches in dialogical ways. Thus, the main objective of this article

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is to discuss the philosophy of ethnomodeling as a creative insubordination of mathematics education and also as a process of glocalization.

Keywords: Creative insubordination, Ethnomodeling, Global approach, Glocal approach, Local approach.

Resumo

A aplicação de métodos de modelagem tem sentido para os pesquisadores e educadores quando esses profissionais examinam os padrões matemáticos desenvolvidos pelos membros de culturas distintas. Atualmente, uma questão importante na educação matemática é a sua tendência em valorizar uma orientação local em seu paradigma de pesquisa. Assim, é necessária uma busca por metodologias inovadoras, como a etnomodelagem, para registrar as formas históricas das ideias, procedimentos e práticas matemáticas desenvolvidas em diversos contextos culturais. No entanto, a etnomodelagem não é uma tentativa de substituir a matemática escolar/acadêmica globalizada, porém, é necessário reconhecer a existência do conhecimento matemático local no currículo escolar. Esse contexto possibilitou o surgimento da insubordinação criativa da etnomodelagem ao evocar uma perturbação que provocou uma revisão das regras e regulamentos no processo de modelagem matemática. Esse processo desencadeou um debate sobre a natureza da matemática em relação à cultura ao propor um diálogo entre as abordagens locais e globais de maneiras dialógicas. Assim, o principal objetivo deste artigo é discutir a filosofia da etnomodelagem como uma insubordinação criativa da educação matemática e como um processo de glocalização.

Palavras-chave: Insubordinação Criativa, Etnomodelagem, Abordagem Global, Abordagem Glocal, Abordagem Local.

Resumen

La aplicación de métodos de modelación tiene sentido para investigadores y educadores cuando estos profesionales examinan los patrones matemáticos desarrollados por miembros de culturas

distintas. Actualmente, un tema importante en la Educación Matemática es su tendencia a valorar una orientación local en su paradigma de investigación. Así, es necesaria la búsqueda de metodologías innovadoras, como la Etnomodelación, para registrar las formas históricas de las ideas, procedimientos y prácticas matemáticas desarrolladas en diferentes contextos culturales. Sin embargo, la Etnomodelación no es un intento de reemplazar las Matemáticas escolares/académicas globalizadas, sin embargo, es necesario reconocer la existencia de conocimientos matemáticos locales en el currículo escolar. Este contexto posibilitó el surgimiento de la insubordinación creativa de la Etnomodelación al suscitar una perturbación que provocó una revisión de las reglas y normas en el proceso de Modelación Matemática. Este proceso provocó un debate sobre la naturaleza de las Matemáticas en relación con la cultura al proponer un diálogo entre enfoques locales y globales de manera dialógica. Así, el principal objetivo de este artículo es discutir la filosofía de la Etnomodelación como una insubordinación creativa de la Educación Matemática y también como un proceso de glocalización.

Palabras clave: Insubordinación Creativa, Etnomodelación, Enfoque Global, Enfoque Glocal, Enfoque Local.

Résumé

L'application des méthodes de modélisation est significative pour les chercheurs et les éducateurs lorsque ces professionnels examinent les modèles mathématiques développés par les membres de cultures distinctes. Actuellement, une question importante dans l'enseignement des mathématiques est sa tendance à valoriser une orientation locale dans son paradigme de recherche. Ainsi, la recherche de méthodologies innovantes telles que l'ethnomodélisation est nécessaire pour enregistrer les formes historiques des idées, procédures et pratiques mathématiques développées dans divers contextes culturels. Cependant, l'ethnomodélisation n'est pas une tentative de remplacer les mathématiques scolaires/académiques mondialisées, mais il est nécessaire de reconnaître l'existence de connaissances mathématiques locales dans

le programme scolaire. Ce contexte a permis l'émergence de l'insubordination créative de l'ethnomodélisation en évoquant une perturbation qui a provoqué une révision des règles et règlements du processus de modélisation mathématique. Ce processus a déclenché un débat sur la nature des mathématiques par rapport à la culture en proposant un dialogue entre les approches locales et globales de manière dialogique. Ainsi, le principal objectif de cet article est de discuter de la philosophie de l'ethnomodélisation en tant qu'insubordination créative de l'enseignement des mathématiques et aussi en tant que processus de glocalisation.

Mots-clés : Insubordination créative, Ethnomodélisation, Approche globale, Approche glocale, Approche locale.

Philosophical concepts of creative insubordination in ethnomodelling research

The recognition of the relation between culture and mathematics can be interpreted as a reaction to *cultural imperialism* that imposed its own version of mathematical knowledge on colonized communities in the known world with the expansion of great navigations from the 15th century onwards. For example, D'Ambrosio (2006), states that:

> The history of Western mathematics from its earliest generation and organization as a corpus of knowledge, in the Mediterranean basin, its expansion to Europe and later, in the era of the great navigations, to the entire world. It is fundamental to recognize the contributions, in this process, of other cultures [an cultural groups] and the importance of the dynamics of cultural encounters. Culture is understood in its widest form, which includes art, history, languages, literature, medicine, music, philosophy, religion and science (p. 78).

In order to continue to operate with current school/academic development models, members of other cultures have been forced to adapt to these mathematical paradigms or perish. Therefore, mathematics can perpetuate imperialist goals and is therefore perceived as a secret weapon that maintains the imposition and domination of Western cultural values on local cultures (Bishop, 1990).

The historical and epistemological dimensions of ethnomathematics as a program bring understanding of how mathematical ideas, procedures, and practices were locally developed and how they evolved, during history, into a corpus of knowledge known as school/academic mathematics, and how it spread into the entire world (D'Ambrosio, 2006).

Hence, school/academic mathematics is criticized since it contributes to reinforcing the Eurocentric approach that prevails in the school curriculum, as well as an aid to the process of globalization of particular types of mathematical ideologies and technologies that support the maintenance of sociocultural imperialism (D'Ambrosio & D'Ambrosio, 2013).

However, the development of non-prescriptive or descriptive strategies for solving problem-situations in various social and cultural domains is an alternative method, as well as an important tool to identify innovative techniques for solving mathematical ideas, procedures

and practices in ethnomodelling research, which is transcultural and transdisciplinarian (Rosa & Orey, 2017).

It is noteworthy to state that ethnomodelling is an alternative methodological approach that can be considered as an application of ethnomathematics intended to add cultural perspectives to the modelling process (Rosa & Orey, 2012).

For example, the results of the study conducting by Cortes (2017) showed that during the functioning of a daily farmer's market in Brazil, it was possible to recognize the development of local mathematical practices to determine the sale prices of his products and then model them by elaborating ethnomodels that showed the connection between local (emic) e global (etic) mathematical knowledge through glocal representations (cultural dynamism), which dealt with the encounters of distinct cultures in the school environment.

The historical relations between culture and mathematics illustrate that this knowledge field is related to its sociocultural aspects. Consequently, the culturally specific nature of mathematics must be recognized in order to describe the mathematical ideas and procedures practiced among members of distinct cultures (D'Ambrosio, 1990).

Thus, the reaction to the cultural imperialism imposed by Western mathematics may also be related to the development of *creative insubordination*[3] *concepts* (Crowson; Morris, 1982), which is related to flexibility of rules, norms, and regulations with the objective of achieving the well-being of members of different cultures.

In this context, it is important to apply alternative methodological approaches such as ethnomodelling so that local mathematical practices can be used to record the historicity of mathematical ideas, notions, and procedures that develop in diverse cultural contexts, as

[3]The concepts of C*reative insubordination*[3] *concepts* (Crowson & Morris, 1982), *responsible subversion* (Hutchinson, 1990) and *positive deviance* (Zeitlin, Ghassemi; Mansur, 1990) are equivalent, as they are concerned with the flexibility of rules, norms, and regulations in order to achieve the well-being of members of distinct cultural groups (Rosa & Orey, 2015a).

members of distinct cultural groups use innovative mathematical solutions to the challenges faced in their daily lives (Rosa & Orey, 2012).

As a process of creative insubordination, ethnomodelling aims at changing existing external paradigms and their conflicts with prevailing values and norms (Marzano, Waters, & McNulty, 2005) in the mathematical curriculum, as it represents the development of mathematical ideas, procedures and practices that are rooted in different cultures. In this context, ethnomodelling links contemporary visions of ethnomathematics and, simultaneously, recognizes the need to develop a vision culturally based on modelling concepts and processes.

For Cortes and Orey (2020), the notions that the modelling process is culturally linked can encourage studies in mathematics education regarding local communities, as they bring cultural aspects to the mathematics teaching and learning process. This approach reveals aspects of creative insubordination in the ethnomodelling process.

For example, Lyman, Ashby and Tripses (2005) argue that these aspects are identified as an ongoing movement that aims to challenge the *status quo* of school/academic mathematical knowledge, as it pursues to subversively modify the education system, in a responsible way, to better serve the needs of members of the school community. This process essentially involves the analysis of perspectives that are external to current pedagogical models and traditional educational systems.

Similarly, Rosa and Orey (2015b) argue that ethnomodelling can be considered an insubordinate and creative educational approach, as it interrupted the existing order in the modelling process by disregarding the linearity of the teaching and learning process in mathematics prevalent in schools because traditional mathematical modelling process is based only on the application of problem-solving procedures in decontextualized situations and phenomena.

In this direction, Rosa and Orey (2015b) argue that ethnomodelling can be considered an insubordinate and creative educational approach, as it interrupted the existing order in the modelling process by disregarding the linearity of the teaching and learning process in mathematics prevalent in schools because traditional mathematical modelling process is based only on the application of problem-solving procedures in decontextualized situations and phenomena.

In this context, in the school mathematics curriculum, Erbas, Kertil, Çetinkaya, Çakiroglu, Alacaci, and Bas (2014) state that "mathematical modelling is often confused with traditional word problems" (p. 1623) because "real-life contexts in these problems are often not sufficiently realistic and thus fail to support students' abilities to use mathematics in the real world" (p. 1623).

Philosophically, ethnomodelling involves the study of ideas, procedures and mathematical practices that are found in diverse cultural contexts to use them in the pedagogical action of ethnomodelling. In this approach, there is flexibility in the bureaucratic norms and rules of school/academic mathematics to recognize diverse problem-solving techniques and value the diverse modes of mathematical knowledge creation by members of distinct cultures (Rosa & Orey, 2015a). According to this context, Ernest (2016) affirms that:

> Philosophy is about systematic analysis and the critical examination of fundamental problems. It involves the exercise of the mind and intellect, including thought, enquiry, reasoning and its results: judgements, conclusions, beliefs and knowledge. There are many ways in which such processes as well as the substantive theories, concepts and results of past enquiry can be applied to and within mathematics education (p. 4).

This context enables members of different cultural groups to challenge and critically and reflectively analyze through ethnomodelling the traditional mathematical thinking prevalent in current educational systems. This approach is related to a form creative insubordination, as it involves thoughts and/or actions that differ from the norms and

regulations imposed by the educational system, as well as it examines how these members solve problems they face in their daily lives (Rosa and Orey, 2019).

For example, the study conductec by Pradhan (2017) showed how Chundara artisans in Nepal generated knowledge in relation to the mathematical ideas that were both embedded and used in the construction of wooden artifacts, such as drums. What is of particular value is his discussion in relation how the artisans transformed a truncated cone to a cylinder in the construction of drums that can be analysed through the development of ethnomodels.

Since, historically, mathematical knowledge takes diverse forms in different cultures through the development of techniques and procedures that often oppose the formal system and/or the rules commonly legitimized by the school system and/or academia; therefore, the school/academic paradigms about the notions of modelling show that this process is culturally rooted. Thus, the main objective of this article is to discuss the philosophy of ethnomodeling as a creative insubordination of mathematics education and also as a process of glocalization.

Local (emic), Global (etic) and Glocal (dialogic) approaches to Ethnomodelling

When researchers investigate members of distinct cultural groups, they may find diverse characteristics of mathematical ideas and procedures that we may label ethnomodelling. However, the external (global, etic) understanding of *cultural traits*[4] can be a misinterpretation of the mathematical practices developed in these groups, as these members often have their own interpretation of these traits, including mathematical knowledge passed on from generation to generation.

[4]Cultural traits are specific attributes, defined by members of distinct cultures, which have visible or cognitive characteristics that are developed from the performance of activities practiced in their daily life. These traits favor the development of the cultural identity of these members, as they are related to the appreciation of culture, religion, language, government, customs, arts, traditions and social organization, as well as the establishment of solid relationships among these members (Rosa & Orey, 2017).

According to this context, there are three approaches called global (etic[5]), local (emic) and glocal (dialogic/cultural dynamism) to be considered in investigations of mathematical ideas, procedures, a practices developed by members of distinct cultures.

Global Approach (Etic, Universal)

The global approach (etic, universal) is considered as an *outside* or external view on beliefs, customs and scientific and mathematical knowledge developed by members of different cultural groups. This process inculcated an ethnocentric predominance that triggered a lack of interest and disrespect for the diverse and different ways of producing mathematics in relation to the symptoms of *cultural otherness*[6] (Rosa and Orey, 2010).

This approach is considered as *culturally universal* (Sue and Sue, 2003). In this context, Zhu and Bargiela-Chiappini (2013) argued that "certain approaches to culture teaching and learning may fail to develop students' understanding of *cultural sensitivity*[7] in increasingly multicultural workplaces" (p. 380). Consequently, one of the mains reasons for the development of traditional educational systems is its reliance on universal dimensions of knowledge (Hofstede, 2001).

In accordance with Rosa and Orey (2019), this globalization process deals with cultural convergences that understand mathematical knowledge in terms of increasing homogenization

[5]The terms emic and etic were originally introduced by Pike (1967), who drew them on an analogy with phonemic and phonetic linguistic terminology. Phonetics are the general aspects of all possible vocal sound productions in languages. Phonemes are the significant local sounds that are used in a specific language. Thus, as in the study of a language's sound system, it is possible to apply at least two approaches in the investigation of distinct cultures, which are the point of view of locals (emic, insiders, from within the culture) and of external observers (etic, outsiders, from outside of the culture).

[6]Cultural otherness is the process by which cultures, communities or societies can exclude a particular group of people because of their otherness (differences). Thus, this term incorporated a negative connotation due to practices related to stereotypes that allow people to use social markers to build their identity (Wexler, 2004). However, currently, alterity is a positive posture, which is related to a state or a quality that is constituted through relations of difference, contrast and distinction between different cultures (Rosa & Orey, 2017).

[7]Cultural sensitivity is the knowledge, awareness, and acceptance of other cultures and others' cultural identities. In this context, people are aware that cultural differences and similarities between members of distinct cultural groups exist without assigning them a value, such as positive or negative, better or worse, and right or wrong. It also means that people are aware and accepting of cultural differences withhold judgment of cross-cultural practices, and that they can deal effectively with these differences, (Kubokawa, 2009).

since it denies and ignores the diversity of cultures in their social, cultural, political, economic, environmental and geographic limits and often examines school/academic mathematical constructs as certain, correct, universal, and monolithic and rigid uniform whole of knowledge that originate in the academic and institutional tradition.

Local Approach (Emic, Specific)

The local (emic, specific) approach is considered as the inside or inner vision of the members of distinct cultural groups about their own customs, beliefs, and traditions, which are related to mathematical knowledge that encompasses skills, competences, experiences, ideas, and practices locally developed, which are used to solve daily problems in order to maintain and/or improve their standard of living.

The focus of local knowledge is the dynamic interaction between members of different cultures. This knowledge has continually developed and adapted in diverse cultural contexts that have changed throughout history and intertwined with its own values (Rosa and Orey, 2019). The global approach is based on extrinsic concepts and external categories that only have meaning for researchers and educators who are the only judges of the validity of etic narratives (Rosa & Orey, 2017).

Local knowledge is also called *cultural and social capital*[8] that was developed by members of different cultures as the main resources used in the struggle for survival and transcendence (Rosa, 2010). In this regard, "emic approach is defined as the insiders' perspective on culture (from within a specific culture) which provides insight into cultural nuances and complexities (Pike, 1967 cited in Zhu and Bargiela-Chiappini, 2013, p. 381).

[8]Social capital is the sum of resources, real or virtual, that are accumulated by members of different cultural groups by virtue of having a lasting network of relationships, mutual knowledge and recognition. Cultural capital includes non-economic resources that enable social mobility, such as knowledge, skills and education. In both concepts, social networks and cultures are valued and respected (Bourdieu & Wacquant, 1992).

For example, for Yifeng (2009), local knowledge influences worldviews, but it is important to understand how this knowledge is changed, at different times and places, according to political, social, economic, environmental and cultural contexts. This approach is considered as *culturally specific* (Sue and Sue, 2009).

Glocal Approach (Dialogic/Cultural Dynamism)

The glocal approach (dialogic/cultural dynamism) is considered as the dialogical relation between globalization (etic knowledge) and localization (emic knowledge). This approach is called *glocalization*[9] (Robertson, 1995), as it involves the combination and adaptation of two or more knowledge systems or distinct cultures.

However, for glocalization to acquire a culturally significant conceptualization, there is a need to include at least one component that addresses the value or knowledge systems developed in the local culture (Khondker, 2004). For example, Morris, Leung, Ames, and Lickel (1999) cited in Zhu and Bargiela-Chiappini (2013) state that:

> (…) we should look at the emic and etic as points on a continuum. Further, they argue that integration of the two approaches overcomes their inherent weaknesses: the emic approach can be biased as it relies exclusively on researchers' interpretations, while the etic may miss out the richness of culture(s). The emic-etic continuum conceptualization affords rich accounts of culture and organizational behavior (emic). Specifically, the historicist logic underpinning the emic provides detailed interpretations by insiders, while the functionalist logic characterizing the etic seeks transhistorical generalizations useful for comparing cultures (p. 382).

In glocalization, local (emic) and global (etic) approaches are interdependent and mutually constitutive, as they aim to challenge notions of cultural imperialism. This conceptualization suggests a negotiation process that starts from the inside out, that is, a process that considers the relevance of the dynamics of local with global knowledge (Maynard, 2003). The main objective of the glocal (dialogic) approach is related to its positive deviation, which

[9]Glocalization is a term coined by Robertson (1992) that combines the concepts of globalization and location.

distances itself from established norms, rules, and/or regulations, by modifying institutional regulations with the use of innovation, creativity and adaptability (Walker, 2005).

As glocalization emerged from *cultural dynamism*[10] through interactions between two different cultures through the adaptation of its members to the changes brought about by this dynamism, the dialogic approach is an important aspect in the ethnomodelling process. In fact, the notion of contextualization used in this article is inclusive, as it uses the positive aspects of the globalization of mathematical knowledge in a sustainable way.

Consequently, contextualized mathematical practices do not help to promote forms of academic hegemony, as this kind of mathematics emphasizes dialogical relations between local (emic) and global (etic) approaches through a sense of complementarity that values and respects diverse mathematical knowledge systems (Rosa & Orey, 2017).

In this regard, the dialogic approach in ethnomodelling research can foster the development of *intercultural competences*[11] such as knowledge, attitudes, and skills that are related to the ability of members of distinct cultures to communicate and behave effectively in a variety of cultural contexts in order to solve daily problems (Bennett & Bennett, 2004).

These competences enable the development of specific knowledge, skills and attitudes, which lead members of specific cultural groups towards the evolution of communicative behaviors and actions that are effective and appropriate for the progress of interactions between difference cultural groups (Deardorff, 2006). Figure 1 shows the intercultural competences necessary for the development of the ethnomodelling process.

[10]In cultural dynamism, local knowledge interacts with those consolidated by the (global) school/academy by developing a reciprocal relationship between *know* and *do* developed emically and knowledge developed eticly (Cortes & Orey, 2020).

[11]For Unesco (2009), intercultural competences are resources put into practice during intercultural dialogue. In this sense, Alvarez (2005) states that intercultural competence, especially in the teaching and learning process in formal education, can be understood as the ability to efficiently develop their tasks or functions in multicultural contexts. For Deardorff (2009), this approach seeks to rethink the good exercise of citizenship, as intercultural learning is transformative and requires experiences, often acquired beyond the classroom.

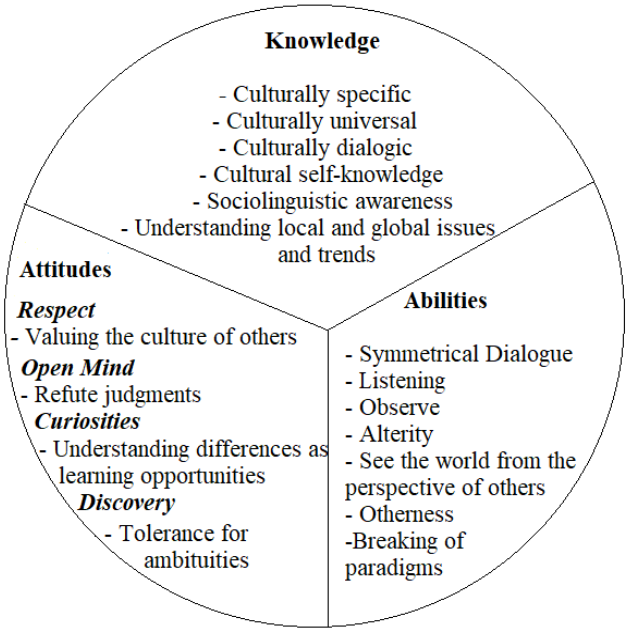

Figure 1. *Intercultural competences in the ethnomodelling process (Adapted from Deardorff, 2006)*

In this regard, Rosa and Orey (2017) argue that the dialogic approach (glocalization) of ethnomodelling helps researchers and educators to become more aware of the forms of hegemony prevailing in mathematics classrooms. Thus, it is necessary to incorporate the forms of knowledge rooted in culture and the ongoing changes that arise in the teaching and learning process of this curricular component. For example, inspired by Freire (1970), Skovsmose (2016) argues that the:

> (…) notion of dialogue has played an important role in the formulation of critical mathematics education. Dialogic teaching and learning has been presented as one way of developing broader critical competences related to mathematics (…). Dialogic teaching and learning concerns forms of interaction in the classroom. It can be seen as an attempt to break at least some features of the logic of schooling (…) (p. 11).

In our point of view, this glocal approach of ethnomodelling research is a reaction to globalization and/or an appreciation of the cultural identity of members of local communities in which mathematical knowledge considers global connections in conjunction with specific conditions of local knowledge. This insubordinate aspect of mathematics education is creative because it involves adapting rules to change, challenge or even subvert the regulation of the establishment and implementation of norms, which "applies philosophical methods to a critical

examination of the assumptions, reasoning and conclusions of mathematics education" (Ernest at al., 2016, p. 2).

In this regard, Ernest et al. (2016) states that there is a necessity to further expand the concept of philosophy of mathematics education in order to include the diverse applications of philosophical processes, methods and critical modes of thought. In his point of view, it is important to consider and discuss the "application of philosophical concepts or methods, such as a critical attitude to claims as well as detailed conceptual analyses of the concepts, theories, methodology or results of mathematics education research, and of mathematics itself" (p. 4).

Therefore, it is important to highlight that the philosophy of ethnomodelling as a creative and insubordinate approach to mathematics education is relevant to the development of pedagogical actions in classrooms because:

> (…) it gives people new 'glasses' through which to see the world. It enables people to see beyond official stories about the society, mathematics, and education. It provides thinking tools for questioning the status quo, for seeing 'what is' is not what 'has to be'; enabling us to imagine alternatives possibilities (Ernest at al., 2013, p. 2).

It is also important to clarify that there is no proposition of another form of dualism, which is related to globalization (etic) versus localization (emic), as the intention is to contest the narrow understanding of globalization, given that this approach can enable the development of mathematical ideas, procedures and practices regarding alternative and/or innovative traditions.

This procedure is necessary in order to demonstrate that global approaches to knowledge are not necessarily exclusive constructs, as they coexist with localization through a dialogical process of mutual and continuous interactions. For Orey and Rosa (215a), this approach helps researchers and educators to examine the limitations and advantages of using knowledge systems arising from diverse and different views of the world, thus developing a contextualized pedagogical action of mathematical knowledge.

Ethnomodelling as a glocalization process

The debate between local (emic) and global (etic) mathematical knowledge traditions has a history of research on anthropology and mathematics education. According to Headland, Pike, and Harris (1990), some researchers have drawn distinctions between culturally specific (emic) and culturally universal (etic) approaches.

Consequently, Pike (1967) argues that some conflicting situations emerged with the assumption that this difference would imply the study of dichotomous cultural approaches. In this regard, Zhu and Bargiela-Chiappini (2013) commented that according to Harris (2000) the "debate around emic-etic approaches in general represents a clear divide, with preference for either the emic or the etic as the ultimate explanation" (p. 382).

In this context, Zhu and Bargiela-Chiappini (2013) affirmed that there is a necessity to propose a combination of emic and etic approaches by proposing their complementarity into two different ways:

a) the emic can provide an in-depth understanding of cultural preferences such as to introduce local (emic) resources as components of linguistic repertoires to complement the etic approach to cultural learning.

b) emic knowledge provides elements for discoveries about cultures and the basis for their revitalization since etic concepts and theories may be derived from emic (re)sources or were originally emic in their conceptualization. This means that "emic insights could eventually generate etic dimensions" (p. 383).

Thus, the local or emic approach seeks to understand phenomena and comprehend daily activities and phenomena from the point of view of members belonging to distinct cultures (Pelto & Pelto, 1978), as these individuals are the only judges of the legitimacy and validity of the description of local phenomena in their own mathematical terms and contexts. This approach focuses on the study of sociocultural aspects and understanding of mathematical

phenomena in a specific cultural context as members of that culture understand them (Gudykunst, 1997).

The global or etic approach seeks to understand phenomena through the use of concepts and analytical tools related to the worldview of external observers (Pelto; Pelto, 1978). This approach analyzes human knowledge and behavior with a focus on *universality*, as they can be compared across cultures using common metrics and definitions (Berry, 1969).

Generally, the local approach highlights the views developed by members of different cultural groups while the global approach emphasizes the worldviews of observers outside those cultures. Thus, they are complementary, as this combination develops the deepening of these members' understanding of mathematical cultural aspects (Rosa; Orey, 2015b). On the other hand, cultural prejudices occur when researchers and educators assume that a local (emic) construct has a global (etic) origin.

For example, this result mistakenly imposes the predominance of culturally universal mathematical knowledge for mathematical ideas, procedures and practices that are culturally specific or local, as they were emically developed through the dynamics of members of distinct cultural groups.

The study of cultures carried out according to pre-established practical procedures hinders the discovery of cultural diversity. However, its emic analysis can broaden this view (Headland, Pike; Harris, 1990), as it focuses on behavior and exclusive knowledge cultures or the diverse ways in which etic activities are carried out in specific cultural contexts (Cortes & Orey, 2020).

It is important to emphasize that the etic approach is equated with the objective explanation of sociocultural and mathematical phenomena from external points of view while the emic approach is identified with the understanding of subjective experiences according to the internal point of view of the members of a given cultural group (Harris, 1980). Thus, local

and global approaches to mathematical knowledge should not be studied in isolation, but as mutually constitutive parts of a single reality.

In this context, Rosa and Orey (2017) argue that ethnomodelling provides a lens through which it is possible to perceive both the homogeneity and heterogeneity of ideas, procedures and mathematical practices by enabling members of distinct cultures to develop their understanding of local reality as a reaction to specific responses to global forces through glocalization.

For example, the results of the study conducted by Cortes (2017) show that ethnomodelling provided an integrative approach to the school mathematics curriculum, as it considered both emic (local) and etic (global) mathematical knowledge so that teachers and students could understand in a holistic and comprehensive way (dialogic/glocal) the mathematical information developed by these members that make up the school population.

Thus, glocalization occurs when local (emic) and global (etic) mathematical approaches interact through a dynamic that finds reference in the combination of cultural traits developed in different cultural groups so that patterns unknown to outside observers of the culture can be created. This phenomenon means the interpenetration of the local (emic) with the global (etic) approach and vice versa, which can result in *hybridized cultural traits*[12].

According to Robertson (1995), this combination can be perceived as local globalization or global localization. Thus, Rosa and Orey (2019) state that ethnomodelling process values the complementarity of ideas and cultural procedures in innovative products in relation to mathematical practices developed in different contexts. The exclusivist paradigm of

[12]The concept of cultural hybridism is understood under a political bias that is established through interactions between global and local cultures. The hybridization process can guarantee the survival of the local culture and direct the global culture towards a modernization process. In this case, cultural hybridism considers the rupture of the idea of purity, as it is a multicultural practice enabled by the natural encounter between distinct cultures (CANCLIN I, 2011).

globalization does not help members of different cultural groups to realize the disempowerment and loss of mathematical traditions, as well as the limitations of a hegemonic worldview.

On the other hand, a single and extreme defense of the localization process also does not contribute to the training of students in the application of multiple representations of their mathematical creativity in regard to the resolution of problem-situations they face on a daily basis (Cortes & Orey, 2020). Therefore, this dialogic process (glocalization) provides opportunities to challenge both forms of hegemony, as it allows multiple opportunities for the interaction of ideas, procedures and mathematical practices with contextualized actions.

Throughout history, humankind has developed tools that have enabled members of distinct cultural groups to explain, understand and comprehend the world around them. Therefore, transcendence enabled the development of tools, techniques, codes and communication skills that helped humankind to expand the perception of the past, present and future (D'Ambrosio, 2015).

Furthermore, mathematical knowledge is organized through techniques and strategies that develop the representations of reality explanation systems (ethnomodels) about phenomena that take place in everyday life.

Ethnomodels as local, global and dialogic representations

Using ethnomodels, humankind seeks to understand the world through organized explanations using procedures, techniques, methods and theories, as it aims to explain daily events and phenomena. According to D'Ambrosio (2015), these strategies are historically organized in all cultures as knowledge systems.

For Rosa and Orey (2015b), if researchers and educators are not overshadowed by their worldview, these professionals can develop an awareness on the existence of a diversity of mathematical ideas, procedures and practices, which can be modeled, to inform external

observers (global, etic) about the characteristics of mathematical knowledge that are important to members of distinct cultural groups (local, emic) and vice-versa.

Ethnomodelling tends to privilege the organization and presentation of ideas, notions and mathematical procedures developed by these members by encouraging the elaboration of local, global and glocal ethnomodels. Thus, Rosa and Orey (2013) state that the elaboration of representations that can help these members to understand and comprehend the world is carried out through the use of small information units, called ethnomodels, which link the cultural heritage of the members of these groups with the development of their mathematical practices.

One of the main objectives of the elaboration of ethnomodels is to investigate and understand phenomena and their structural interrelations through the *eyes* of members of different cultures. These ethnomodels intend to develop a descriptive idiographic orientation that aims to describe the meaning of contingent, unique and often subjective mathematical phenomena, which emphasize the uniqueness of the mathematical practices developed by these members.

Emic (local) ethnomodels reflect observations that represent the vocabulary and jargon of members of distinct cultures, as well as their scientific and mathematical knowledge, conceptual categories, languages and expressions, and their belief systems. These ethnomodels deal with the diversity of mathematical knowledge and traditions that differ from the (local) natives' point of view (Rosa & Orey, 2013).

Etic (global) ethnomodels reflect the information collected in terms of researchers' and educators' conceptual systems and categories. The aim of these ethnomodels is to identify school/academic relations and causal explanations that are valid in these cultural groups, as they are elaborated from the perspective of external observers about the world being modeled (Rosa & Orey, 2013).

Dialogic (glocal) ethnomodels capture the interpretation processes of members who are *inside* (insiders, local) or *outside* (outsiders, global) of a given cultural group. However, while rooted in an understanding of local mathematical ideas, procedures, and practices, these ethnomodels also embody global mathematical knowledge, as they recognize the many ways in which the glocal mathematical approach works simultaneously (Cortes and Orey, 2020).

They also highlight structural constraints as well as individual and collective agencies when referring to real-world endeavors that can (re)contextualize global mathematical phenomena regarding local cultural traditions, as they recognize the co-presence of similarities and differences, as well as the intensified interpenetration of the local and the global (Giulia et al., 2007) in the process of elaborating glocal ethnomodels.

Thus, in the elaboration of ethnomodels, if researchers wish to elaborate descriptions about the universal (global, etic) aspects of mathematical knowledge, these statements must be formulated in an abstract way and, also, based on attributes of mathematical patterns found in many cultures. On the other hand, if researchers want to highlight the meaning of these generalizations in specific ways (local, emic), then it is necessary to reference a more accurate specific mathematical knowledge (Rosa & Orey, 2017).

In this context, it is important to recognize the interaction of globalization and location and the fact that individuals are microcosmic reflections of how globalization works at the local community level (Mendis, 2007). Thus, glocal ethnomodels incorporate knowledge systems arising from local and global cultural practices through dialogic approaches. For Rosa and Orey (2015a), this approach helps to organize the pedagogical action that takes place in classrooms through the use of local aspects of these mathematical practices.

Global characteristics of translations between mathematical knowledge systems

Questions about cultural differences are examined in the context of ethnomodelling, as researchers and educators often use *translation* to describe the modelling process between

different mathematical knowledge systems (Rosa & Orey, 2013), which depends on "acts of translation between emic and etic perspectives" (Eglash et al., 2006, p. 347).

Therefore, one of the main goals of ethnomodelling is to understand the relations between etic mathematical ideas and the procedures incorporated in local mathematical practices (designs, patterns, proportions, and symmetries) to global and local conceptual structures (Rosa & Orey, 2012).

In this context, Eglash et al. (2006) claim that mathematical practices can be perceived as arising from emic rather than etic origins. However, in some cases, the translation of mathematical knowledge between these approaches is straightforward and simple, for example, in the analysis of several counting systems or calendars. In other cases, mathematical knowledge is *embedded* in complex mathematical processes, such as iteration in bead and balls work and in the Eulerian paths of sand drawings.

In this direction, the results of the study conducted by Eglash et al. (2006) show that often local (emic) mathematical knowledge, such as the application of symmetry classification in crystallography to local textile designs and patterns, is merely analyzed from a global (etic) approach. In this process, Séguinot (1995) argues that translators need to understand the cultures whose local practices they are translating.

An important aspect of the creative insubordination of the ethnomodelling process is related to the fact that local mathematical knowledge is redefined according to the conceptual foundations of glocalization. Thus, this knowledge is valued through translations carried out between different fields of knowledge, which enable contact with differences by encouraging members of distinct cultural groups to interact with each other.

Thus, translation conceptualizes the relation between global and local mathematical knowledge (Rosa & Orey, 2017). In the encounters between these members, alterity enables, mainly, the appreciation of the knowledge of *others*, through translations, without submitting

them to preconceived notions of consolidated paradigms in educational and/or academic systems. This attempt highlights *translatability*[13] as an operational mode arising from the underlying assumptions that guide cultural comparisons and typologies (Iser, 1994).

In this regard, an important translational process occurs when two or more cultures meet and interact as the linguistic, scientific, and mathematical knowledge of the members of a given cultural group is shared in the interpretive domain of the *others* (Iser, 1994). This approach seeks to promote unique forms of the cultural configuration between these groups, as well as encouraging dynamic discussions on the inability of members of the dominant culture to appreciate other cultures (Rosa & Orey, 2012).

Hence, the dialogic (glocalization) approach to ethnomodelling explores the diverse political, social, cultural, environmental, and economic forces that shape the products and processes of *transcultural*[14] and *translational mathematical phenomena*[15], which seek to understand the links and tensions between local (emic) and global (etic) approaches.

It is important to emphasize here that, in this context, ethnomodelling emerges insubordinate, as it intends to provide students with a critical, reflective, and methodological structure so that they can, in a creative way, analyze the complex interactions within and between distinct cultural groups in relation to local mathematical practices through the elaboration of ethnomodels.

Consequently, this approach proposes a complex, dynamic, and interactionist relation between local and global mathematical discourses that are reflected in this translational process

[13]In translatability, members of different cultural groups become aware that identities are subject to the plane of history, politics, representation and difference. Thus, these members choose to maintain the tradition or enable transformation through translation. This approach directly influences new (or old) forms of cultural identity. Then, it is in this movement/displacement that the concept of hybrid cultures between tradition and transformation (translation) emerges as one of the different types of cultural identity (Robins, 1991).
[14]Transculturality is related to the notions of reciprocity in learning, communication and human relationships, being inspired by a humanistic worldview that encourages the promotion of dialogue, respect for differences and mutual understanding, as there is a concern with communication between members from distinct cultural groups.
[15]The term translational is related to the transformation of a mathematical practice through translations between diverse mathematical knowledge systems.

in a dialogic manner, which values cultural specificities inherent to the members of diverse traditions and distinct cultures.

In this context, the concept of creative insubordination is useful for ethnomodelling, as it offers researchers and educators a well-founded and solid basis for decision-making when expected actions collide with the very perception of the mathematical curriculum. This concept involves an intentional act of softening curriculum rules to better serve students by contextualizing daily activities in the classrooms (Rosa & Orey, 2015a).

For example, most of the traditional methodologies used in mathematical modelling investigations in the last three decades do not consider the implications of cultural aspects of local systems in this process. Therefore, it is important that researchers and educators, who are insubordinate and creative, can question and discuss the *status quo* of mathematical knowledge in order to implement significant changes in the mathematics teaching and learning process that takes place in classrooms (Rosa & Orey, 2017).

In accordance with this context, it is necessary to point out here that recent studies and investigations on mathematical modelling, such as ethnomodelling, ethnocomputing, and socioepistemology, bring innovative insights to the modelling process developed in the classrooms (Rosa & Orey, 2017).

For example, Leung, Stillmann, Kaiser, and Wong (2021) argue that "consideration of mathematical modelling in its cultural context and sharing and contrasting research and practices from different cultures, will bring out the richness of mathematical modelling education" (p. 4), and thus it is "important for mathematical modelling and its teaching and learning to be considered in its cultural context" (p. 4).

In this regard, Leung et al. (2021) state that since both mathematics itself and mathematics education are human products and solving problems in real-life context is at the

heart of mathematical modelling and its applications, mathematical modelling and its teaching and learning should be considered in their cultural contexts.

There is a need to highlight that one of the main goals of ethnomodelling is to add cultural components to the modelling process. Thus, rather than being considered another research paradigm, ethnomodelling aims to encourage the search for mathematical ideas, procedures and practices that are culturally rooted for their analysis and adoption in the mathematical curriculum (Rosa & Orey, 2015b).

Similarly, Cortes (2017) states that ethnomodelling helps students to develop mathematical concepts and practices that originate in their own cultural traditions. In this way, the understanding of local mathematical practices can contribute to a broader understanding of academic mathematical knowledge.

Hence, understanding the acts of creative insubordination in the mathematics teaching and learning process based on ethnomodelling enables the development of teaching strategies that help researchers and educators in making methodological decisions concerning their own pedagogical practices (Rosa & Orey, 2015a). This approach is insubordinate and creative, as it can improve the mathematical performance of students through the modification, adaptation and flexibility of curricular practices.

Final considerations

One of the main issues concerning mathematical knowledge regards the position of researchers and educators in relation to global (etic) and local (emic) approaches. Thus, Rosa and Orey (2012) state that the pedagogical work on the mathematical content developed in classrooms can be based on the worldviews of these professionals, which relate to culturally universal (global, etic), culturally specific (local, emic) or culturally dialogic (glocal, cultural dynamism) approaches in ethnomodelling research.

For researchers and educators operating from (global) etic positions; ideas, procedures and mathematical practices develop in the same way in all cultures while for professionals who take an emic perspective, they understand that cultural factors must be considered in the development of mathematical ideas, procedures and practices, which are developed in social, political, economic, and environmental contexts.

These factors include social, moral and lifestyle values, as members of distinct cultures develop different ways of *doing mathematics* so that their members can understand and comprehend the phenomena that occur in their surroundings (Cortes & Orey, 2020). Consequently, it is important to verify whether there is a need to understand cultural specificity (local, emic) in the context of universal theories and methods (global, etic) that may be susceptible to differences and demands of cultural contextualization.

In this regard, the results of investigations conducted by D'Ambrosio (1990), Eglash et al. (2006) and Rosa and Orey (2012) show that the use of culturally specific perspectives encourages intercultural research to support the development of an emic approach to mathematical knowledge. This context strengthens the notion that mathematics cannot be conceived as a universal language because its principles, concepts and foundations are not the same everywhere (Rosa & Orey, 2015b).

It is equally naive to claim that members of different cultural groups do not share universal mathematical ideas and, therefore, some mathematical activities are widely practiced across cultures (Bishop, 1988). Therefore, if researchers and educators become aware of their worldviews and their paradigms and cultural values, these professionals can become aware of the use of ethnomathematics and modelling in their pedagogical practices through ethnomodelling to assist them in making decisions related to the application of local emic (local), etic (global) and dialogic (glocal) approaches (Rosa & Orey, 2017).

Another insubordinate and creative aspect of ethnomodelling regards the use of the emic approach in the mathematics teaching and learning process, which can be considered as a form of *decolonization*, which is a process that aims to address the historical trauma and unveil the tragic effects of colonization. For example, Laenui (2000) argues that the decolonization process begins with the reduction and/or elimination of colonial exploitation of local heritages from Western cultures. Similarly, glocalization is defined as the critical involvement of reconstruction and mutual appreciation of local and global phenomena (Giulianotti & Robertson, 2007).

Thus, in order to understand the diffusion of mathematical knowledge, it is necessary to jointly analyze local and global reconstructions, as cultural aspects contribute to recognizing mathematics as an integral part of everyday life, that is, as a humanistic construct. In this direction, Rosa and Orey (2015a) state that creative insubordination is important to assist students in the teaching and learning process that is triggered in schools, as institutional rules and norms need to be made more flexible to meet the pedagogical demand of the student body.

Another creative insubordination feature of ethnomodelling is related to its pedagogical action in which according to Zhu and Bargiela-Chiappini (2013) "students can begin to interrogate etic approaches to cultural learning with a view to developing a reflexive, critical attitude toward extant cross-cultural knowledge and an appreciation of the contribution of the emic-etic continuum perspective" (p. 388).

Thus, we agree with Zhu and Bargiela-Chiappini (2013) who state that ethnomodelling "is about the activities in which social actors are involved, their everyday as well as their unique practices, the analysis of which reveals underlying values, beliefs, preferences and norms" (p. 385) that are relevant to solve daily problems and understand sociocultural phenomena.

It is important for researchers and educators to address students' educational and pedagogical needs in this process through the ethnomodelling aimed to value and promote local

mathematical interpretations of cultural symbols, including artifacts, music, folklore, architecture, heritage, spirituality, behavior and geographic landscapes as important characteristics for the development of glocalized knowledge. This approach aims to establish connections between emic (local) and etic (global) knowledge to help students understand mathematical knowledge in a comprehensive and holistic way.

References

Alvarez, M. A. A. (2005). Competencia intercultural, concepto, efectos e implicaciones en el ejercicio de la ciudadanía. *Revista Iberoamericana de Educación*, *35*(5), 1-10.

Bennett, J., & Bennett, M. (2004). Developing intercultural sensitivity: an integrative approach to global and domestic diversity. In: Landis, D., Bennett, J., & Bennett, M. (Eds.). *Handbook of intercultural training* (pp. 147-165). Thousand Oaks, CA: Sage.

Berry, J. W. (1969). On cross-cultural comparability. *International Journal of Psychology*, *4*(2), 119-128.

Bishop, A. J. (1988). *Mathematical enculturation*: a cultural perspective on mathematics education. Dordrecht, The Netherlands: D. Reidel Publishing Company.

Bishop, A. J. (1990). Western mathematics: the secret weapon of cultural imperialism. Race & *Class*, *32*(2), 51-65.

Bourdieu, P., & Wacquant, L. J. D. (1992). *An invitation to reflexive sociology*. Chicago, IL: University of Chicago Press.

Canclini, N. G. (2011). *Culturas híbridas*: estratégias para entrar e sair da modernidade. São Paulo, SP: UNESP.

Cortes, D. P. O. (2017). *Re-significando os conceitos de função*: um estudo misto para entender as contribuições da abordagem dialógica da etnomodelagem. Dissertação de Mestrado Profissional em Educação Matemática. Departamento de Educação Matemática. Ouro Preto, MG: Universidade Federal de Ouro Preto.

Cortes, D. P. O., & Orey, D. C. (2020). Connecting ethnomathematics and modelling: A mixed methods study to understand the dialogic approach of ethnomodelling. *REVEMOP*, *2*(1), 1-25.

Crowson, R. L., & Morris, V. C. (1982). The principal's role in organizational goal-attainment: discretionary management at the school site level. *Proceedings of the Annual Meeting of the American Educational Research Association* (pp. 19-23). New York, NY: AERA, 1982.

D'Ambrosio, U. (1990). *Etnomatemática*: arte ou técnica de explicar e conhecer. São Paulo, SP: Editora Ática.

D'Ambrosio, U. (2006). The program ethnomathematics and the challenges of globalization. *Circumscribere*, *1*, 74-82.

D'Ambrosio, U. (2015). Mathematical modelling as a strategy for building-up systems of knowledge in different cultural environments. In: Stillman, G. A., Blum, W., &

Biembengut, M. S. (Eds.). *Mathematical modelling in education research and practice*: cultural, social, and cognitive influences (pp. 35-44). New York, NY: Springer, 2015.

D'Ambrosio, U., & D'Ambrosio, B. S. (2013). The role of ethnomathematics in curricular leadership in mathematics education. *Journal of Mathematics Education at Teachers College*, *4*(1), 19-25.

Deardorff, D. K. (2006). The identification and assessment of intercultural competence as a student outcome of internationalization at institutions of higher education in the United States. *Journal of Studies in International Education*, *10*(3), 241-266.

Deardorff, D. K. (2009). *The Sage handbook of intercultural competence*. Thousand Oaks, CA: Sage.

Eglash, R., Bennett, A., O'Donnell, C., Jennings, S., & Cintorino, M. (2006). Culturally situated designed tools: ethnocomputing from field site to classroom. *American Anthropologist, 108*(2), 347-362.

Erbas, A.K., Kertil, M., Çetinkaya, B., Çakiroglu, E., Alacaci, C. &Bas, S. (2014). Mathematical modeling in mathematics education: basic concepts and approaches. *Educational Sciences: Theory & Practice, 14*(4), 1621-1627.

Ernest, P. (2016). An overview of the philosophy of mathematics education. In: Ernest, P., Skovsmose, O., van Bendegem, J. P., Bicudo, M., Roger, M., Kvasz, L., & Moeller, R. (Eds.). *The philosophy of mathematics education* (pp. 3-8). ICME-13 Topical Surveys. Cham, Switzerland: SpringerOpen.

Ernest, P., Skovsmose, O., van Bendegem, J. P., Bicudo, M., Roger, M., Kvasz, L., & Moeller, R. (2016). *The philosophy of mathematics education*. ICME-13 Topical Surveys. Cham, Switzerland: SpringerOpen.

Giulianotti, R.; Robertson, (2007). R. Recovering the social: globalization, football and transnationalism. *Global Networks, 7*(2), p. 144–186.

Gudykunst, W. B. (1997). Cultural variability in communication. *Communication Research, 24*(4), 327-348.

Harris, M. (1980). The epistemology of cultural materialism. In: Harris, M. *Cultural materialism:* the struggle for a science of culture (pp. 29-45). New York, NY: Random House.

Headland, T. N.; Pike, K. L., & Marvin Harris (1990). *Emics and etics*: the insider/outsider debate. Newbury Park, CA: Sage Publications.

Hofstede, G. (2001). *Culture's consequence*: comparing values, behaviors, institutions and organizations across nations. Thousand Oaks, CA: Sage.

Hutchinson S. A. (1990). Responsible subversion: a study of rule-bending among nurses. *Scholarly Inquiry for Nursing Practice*, 4(1), 3-17.

Iser, W. On translatability. *Surfaces, 4*, 5-13, 1994.

Khondker, H. H. (2004). Glocalization as globalization: evolution of a sociological concept. *Bangladesh e-Journal of Sociology*, *1*(2), 12–20.

Kubokawa, A., & Ottaway, A. (2009). Positive psychology and cultural sensitivity: a review of the literature. Graduate Journal of Counseling Psychology, 1(2), 130-138.

Laenui, P. (2000). Processes of decolonization. In: Battiste, M. (Ed.). *Reclaiming indigenous voice and vision* (pp. 150-160) Vancouver, Canada: UBC Press.

Leung, F. K. S., Stillman, G. A., Kaiser, G., & Wong, K. L. (2021). Mathematical modelling education in the cultural contexts of west and east. In: Leung, F. K. S., Stillman, G. A., Kaiser, G., & Wong, K. L. (Eds.), *Mathematical modelling education in east and west* (pp. 3-16). Cham, Switzerland: Springer.

Lyman, L. L., Ashby, D. E., & Tripses, J. S. (2005). *Leaders who dare*: pushing the boundaries. Lanham, MD: Rowman & Littlefield Education,.

Marzano, R. J., Waters, T., & McNulty, B. A. (2005). *School leadership that works*: from research to results. Alexandria, VA: Association for Supervision and Curriculum Development.

Maynard, M. L. (2005). From global to local: how Gillette's sensor Excel accommodates to Japan. *Keio Communication Review*, *25*(3), 57-75.

Mendis, P. (2007). *Glocalization*: the human side of globalization as if the Washington consensus mattered. Morrisville, NC: Lulu Press.

Pelto, P. J., & Pelto, G. H. (1978). *Anthropological research*: the structure of inquiry. New York, NY: Cambridge University Press, 1978.

Pike, K. L. (1967). *Language in relation to a unified theory of the structure of human behaviour*. The Hague, The Netherlands: Mouton.

Pradhan, J. B. (2017). Mathematical ideas in Chundara culture: unfolding a Nepalese teaching and learning system. In: Rosa, M., Shirley, L., Gavarrete, M. E., & Alangui, W. V. (Eds.), *Ethnomathematics and its diverse approaches for mathematics education* (pp. 125-152). ICME-13 Monographs. Cham, Switzerland: Springer.

Robertson, R. (1995). Glocalization: time-space and homogeneity-heterogeneity. In: Featherstone, M. (Ed.). *Global modernities* (pp. 25-44). London, England: Sage.

Robins K. (1991). Tradition and translation: national culture in its global context. In: Corner J.. & Harvey S. *Enterprise and heritage*: crosscurrents of national culture (pp. 21-45). Londres, England: Routledge.

Rosa, M. (2010). A mixed method study to understand the perceptions of high school leaders about English language learners (ELL): the case of mathematics. College of Education. Doctorate Dissertation in Education. Sacramento, CA: California State University

Rosa, M., & Orey, D. C (2010). Ethnomodelling: an ethnomathematical holistic tool. *Academic Exchange Quarterly*, *14*(3), 191-195.

Rosa, M., & Orey, D. C. (2012). O campo de pesquisa em etnomodelagem: as abordagens êmica, ética e dialética. *Educação e Pesquisa*, *38*(4), 865-879.

Rosa, M., & Orey, D. C. (2013). Ethnomodelling as a research lens on ethnomathematics and modelling. In Stillman, G. A., & Brown, J. (Orgs.). *Teaching mathematical modelling*: connecting to research and practice (pp. 117-127). Dordrecht, The Netherlands: Springer.

Rosa, M., & Orey, D. C. (2015a). 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. (2015b). Three approaches in the research field of ethnomodelling: emic (local), etic (global), and dialogic (glocal). *Revista Latinoamericana de Etnomatemática*, *8*(2), 364-380.

Rosa, M., & Orey, D. C. (2017). *Etnomodelagem*: a arte de traduzir práticas matemáticas locais. São Paulo, SP: Editora Livraria da Física.

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 – RBEP, 100*(254), 191-209.

Séguinot, C. (1995). Translation and advertising: going global. In: Shäffner, C., & Holmes, K. (Eds.). *Cultural functions of translation* (pp. 55-69) Philadelphia, PA: Multilingual Matters.

Skovsmose, O. (2016). Critical mathematics education: concerns, notions, and future. In: Ernest, P., Skovsmose, O., van Bendegem, J. P., Bicudo, M., Roger, M., Kvasz, L., & Moeller, R. (Eds.). *The philosophy of mathematics education* (pp. 9-13). ICME-13 Topical Surveys. Cham, Switzerland: SpringerOpen.

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

Walker L. O. (2005). *Avant KC strategies for theory construction in nursing*. Boston, MA: Boston Prentice Hall.

Wexler, J. (2004). *Alterity*: theories of media. Chicago, IL: University of Chicago.

Unesco (2009). *Organização das Nações Unidas para a educação, a ciência e a cultura.* Investir na diversidade cultural e no diálogo intercultural: direito humano à educação. Brasília, DF: Unesco.

Yifeng, S. (2009). Cultural translation in the context of glocalization. *Ariel*, 40(2-3), 89–110.

Zeitlin, M., Ghassemi, H.. & Mansur, M. (1990). *Positive deviance in child nutrition:* with emphasis on psychological and behavioural aspects and implications for development. Tokyo, Japan: The United Nations University.

Zhu, Y., & Bargiela-Chiappini, F. (2013). Balancing emic and etic: situated learning and ethnography of communication in cross-cultural management education. *Academic of Managing Learning and Education*, *12*(3), 380-395.