ISRG Journal of Multidisciplinary Studies (ISRGJMS)

OPEN ACCESS

ISRG PUBLISHERS

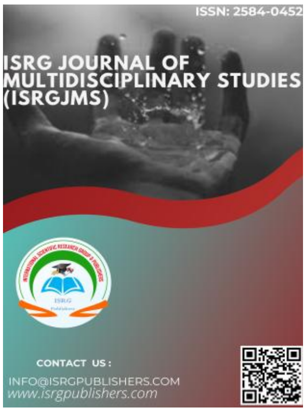
Abbreviated Key Title: isrg j. multidiscip. Stud.

ISSN: 2584-0452 (Online)

Journal homepage: https://isrgpublishers.com/isrgjms/

Volume – IV, Issue – IX (September) 2026

Frequency: Monthly



Mathematical Activity of Playing in Joint Liability Mechanisms: An Ethnomathematical Study of Group Loan Feasibility Simulations in Microfinance Institutions

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| **Received:** 04.09.2026 | **Accepted:** 08.09.2026 | **Published:** 12.09.2026

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Abstract

Group lending schemes in microfinance institutions commonly employ joint liability mechanisms, locally known as tanggung renteng, in which the repayment burden of a defaulting borrower may be redistributed among the remaining members of the group. While ethnomathematics studies have extensively explored mathematical practices embedded in traditional cultural activities, mathematical practices within modern professional and institutional settings remain relatively underexplored. This study examines the mathematical activity of playing, as conceptualized by Bishop, in the simulation of loan feasibility and explores how simulative reasoning extends from individual financial assessment to collective joint liability mechanisms. The study constitutes a focused reanalysis of descriptive qualitative data obtained through an in-depth interview with an Account Officer and document analysis of Debt Burden Ratio (DBR) records from a four-member borrower group at a microfinance institution in Makale, Indonesia. Two contrasting cases were examined: a borrower with adequate financial capacity and a borrower with limited repayment capacity. The findings indicate that playing emerges conditionally when uncertainty regarding repayment capacity requires the Account Officer to explore alternative loan ceilings and corresponding installment amounts. This activity takes the form of bounded exploration because the possible alternatives are constrained by institutional rules and standardized installment tables. Furthermore, a similar simulative pattern appears at the group level when the repayment obligation of a potentially defaulting borrower is projected and redistributed among the remaining members. This study introduces the notion of distributed playing to describe the extension of individual mathematical simulation into collective financial reasoning. The findings contribute to institutional ethnomathematics by demonstrating that mathematical activity in professional settings not only supports administrative decision-making but also contributes to the maintenance of collective solidarity and risk management within group lending systems.

Keywords: *ethnomathematics; Bishop's mathematical activities; playing; joint liability; group lending; microfinance institution*

DOI: 10.5281/zenodo.22722674

INTRODUCTION

Microfinance institutions in Indonesia widely adopt the group lending model, a financing scheme that disburses loans to individuals through group membership, utilizing joint liability mechanisms as the primary risk mitigation instrument (Ledgerwood et al., 2013). Under this mechanism, the default of a member is not entirely an individual responsibility, but is instead shared among other group members (Armendáriz & Morduch, 2010). Although formally designed as a credit risk management instrument, the joint liability mechanism in practice is executed through a series of calculations and numerical simulations carried out by field staff—specifically Account Officers (AOs)—whenever a potential default arises within a group. The study of ethnomathematics, as formulated by D'Ambrosio (1985, 2001), provides a framework to understand such mathematical practices as mathematics arising from the functional needs of specific cultural or professional groups, performed without always being consciously recognized as formal mathematics by the practitioners. In Indonesia, ethnomathematics research has predominantly focused on traditional cultural practices, such as trading transactions in traditional markets (Fradi et al., 2019), coastal community transactions (Siregar & Yahfizham, 2023), Toraja carvings (Jainuddin et al., 2020), or traditional Tongkonan houses (Wahyuni et al., 2023). Ethnomathematical research in modern financial institutions, particularly regarding social mechanisms like joint liability in group lending, remains sparsely explored, despite the mechanism inherently being laden with collective mathematical activities.

A previous study on an AO at PT Bina Artha Ventura Makale Branch identified Bishop's (1991) six mathematical activities in the calculation of the Debt Burden Ratio (DBR) to determine individual partner feasibility. That study found that the activity of playing emerged conditionally during loan ceiling simulations for partners with minimal financial capacity. However, the analysis in that previous study stopped at the individual level. Meanwhile, the same data contained references by the AO to joint liability rules, specifically how a potentially defaulting partner's installment is projected and divided among other group members. This article addresses a distinct topic rooted in the same dataset by further elaborating on how the simulative thinking pattern (playing)—initially found at the individual level—extends into a collective simulation within the joint liability mechanism, a dimension that has not been explicitly discussed in institutional ethnomathematics literature.Based on this background, this article is formulated to address three main research questions:How does the mathematical activity of playing emerge in loan ceiling simulations during the AO's operational practice?How does this simulative pattern extend into the joint liability mechanism at the group level?What are the implications of this extension for the sustainability of group solidarity mechanisms in group lending systems?

Ethnomathematics is understood as mathematics practiced by specific cultural groups, including professional communities, emerging from functional needs and performed without always being consciously recognized as formal mathematical activity (D'Ambrosio, 1985, 2001). In the context of financial institutions, Noss and Hoyles (1996) showed that workers' situational mathematical reasoning is rarely identified as "mathematics" because it is deeply integrated into work procedures and institutional artifacts, such as standardized financing analysis sheets. Bishop (1991) identified six universal mathematical activities: counting, measuring, locating, explaining, playing, and designing. Playing is defined as the activity of constructing and testing hypothetical scenarios or strategies. In professional work contexts, it is not merely recreational, but operates as bounded exploration to find an acceptable solution within specific rule constraints. This concept aligns with Simon's (1957) notions of bounded rationality and satisficing, which explain that decision-makers under constraints of information and time tend to seek solutions that are "good enough" rather than purely optimal in a mathematical sense. At the group level, joint liability theory in microfinance literature (Armendáriz & Morduch, 2010; Ledgerwood et al., 2013) explains that joint liability functions as social collateral that encourages peer monitoring and maintains the group's continued access to financing. In this article, Bishop's framework and joint liability theory are integrated to understand joint liability not merely as an administrative rule, but as an arena where the AO's individual playing activity expands into a form of distributed simulation involving the re-projection of financial burdens across multiple actors.

FINDINGS

Playing as Bounded Exploration in Loan Ceiling Determination

The mathematical activity of playing was identified within a sequence of simulations involving four interconnected components on the DBR sheet: the loan ceiling as the simulated variable, followed by default assumptions and monthly installments that automatically adjusted whenever the ceiling was modified, leading to the final disposable income. The AO explained that for partners with minimal financial capacity, the ceiling is "simulated and offered at a lower amount so that the monthly installment decreases accordingly." This simulation is not an unrestricted exploration; rather, it represents a bounded exploration constrained by pre-calculated values in the company's standardized installment matrix. Consequently, the choices tested by the AO remain strictly within institutionally predefined boundaries (Gravemeijer et al., 2017).

Conditional Emergence of Playing: Contrast Between Two Cases

The activity of playing did not emerge uniformly across all evaluated client cases. In the case of a partner with adequate financial capacity, the AO operated in a confirmative mode, directly processing data without testing alternative loan scenarios. Conversely, when dealing with a partner with constrained repayment capacity, the AO shifted to an exploratory mode, running repetitive trial simulations until a balanced ceiling-installment ratio was attained. This contrast confirms that playing operates as a conditional mathematical activity triggered by situational uncertainty rather than a static routine (Lave & Wenger, 2018).

Extension of Playing to Group Joint Liability Simulations

Documentary evidence from the borrower group revealed varying individual installment amounts among the four members. Under the institutional group lending protocol, if a single member defaults, their monthly payment obligation is projected to be divided equally among the remaining three members. The AO’s application of joint liability guidelines demonstrates that individual financial evaluations are simulative extended to project cross-member risk exposure. When evaluating a high-risk borrower, the AO noted that "the borrower group can still proceed as long as it

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meets the company's minimum threshold of four active members." This indicates that individual credit feasibility simulations inherently evaluate the threshold conditions required for collective group sustainability.

CONCLUSION

This study demonstrates that the mathematical activity of *playing* among microfinance Account Officers emerges conditionally as a bounded exploration during individual credit assessments. Crucially, this simulative reasoning extends into a form of *distributed playing* when evaluating group-level joint liability mechanisms. These findings enrich institutional ethnomathematics by establishing that professional mathematical practices serve dual functions: performing administrative decision-making and actively preserving collective risk-sharing networks within group lending structures. For practical application, microfinance institutions should incorporate explicit joint liability redistribution modeling into Account Officer training programs to enhance situational decision-making accuracy. Future research should investigate how borrowing group members themselves interpret, negotiate, and internalize these distributed mathematical obligations during repayment crises.

ACKNOWLEDGMENT

The author would like to express sincere gratitude to the microfinance institution, particularly the Account Officer and group members, for their valuable time, openness, and cooperation during the data collection process. Appreciation is also extended to Universitas Kristen Indonesia Toraja for the institutional support provided throughout the completion of this study.

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DOI: 10.5281/zenodo.22722674