Al-Jahiz: Journal of Biology Education Research
ISSN 2722-5070 (Print) ISSN 2722-5275 (Online)
Vol. 6 No. 2 July-December 2025
Available online at:
http://e-journal.metrouniv.ac.id/index.php/Al-Jahiz

Exploration of Local Culture as a Learning Resource in STEAM Learning

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Article Information

Article History:
Received: April 24, 2025
Revised: October 13, 2025
Published: November 25, 2025

Keywords:
Cultural integration; STEAM Learning; Traditional games; Local wisdom; Educational innovation.

ABSTRACT

Integrating local cultural elements into education represents a strategic approach to preserving cultural heritage while increasing student engagement in understanding science, technology, engineering, art, and maths (STEAM) concepts. This research employed a qualitative case study approach, conducted in schools in Pangkep Regency. Data were collected through interviews with educators and cultural experts, participatory observations, and document analysis, while the findings were examined using thematic analysis. The objectives of this study are threefold: firstly, to identify local traditional games that can be integrated into STEAM learning; secondly, to analyze their impact on students' cognitive and social skills; and thirdly, to propose effective implementation strategies. The study's results demonstrated that traditional games such as Gandrang Bulo, Magasing-gassing, and Enggo-enggo possess considerable educational potential, enhancing science literacy and motor skills and fostering cultural identity and cooperative learning. However, it is crucial to acknowledge the challenges posed by limited educational resources and teacher readiness, which must be surmounted for the successful implementation of this approach. The study proposes the formulation of a structured curriculum that integrates these cultural elements, to enrich STEAM learning and foster a more profound appreciation of local cultural heritage among students.

How to Cite
Ismirawati, N., Randi, N. Z., Usman, J., & Tharikh, A. J. (2025). Exploration of Local Culture as a Learning Resource in STEAM Learning. *Al Jahiz: Journal of Biology Education Research*. 6(2), 362–376. DOI: https://doi.org/10.32332/al-jahiz.v6i2.10491.

Published by
Al-Jahiz: Journal of Biology Education Research
Website
https://e-journal.metrouniv.ac.id/index.php/Al-Jahiz/index

INTRODUCTION

Education has been identified as playing a significant role in the preservation and promotion of local cultural heritage (Hasanah et al., 2024; Nahak, 2019). In the Indonesian context, cultural preservation is part of a broader strategy aimed at strengthening national identity while fostering national unity. In South Sulawesi, for instance, the cultural identity of the community is preserved through various forms of oral literature, including pantun, hikayat, and myths that are

passed down from generation to generation and serve as a medium for character education (Mulyani & Hapsari, 2025). Furthermore, the values of Bugis-Makassar local wisdom, such as sipakatau, sipakainge, and siri', demonstrate a strong acculturation between Islamic teachings and local traditions, which to this day form the basis of the community's social ethics (Yunus et al., 2022). Cultural festivals that are regularly held in this region also serve as a medium of education and a means of preserving local culture, as they involve community participation in exhibitions, performances, and cultural dialogues (Asyrafunnisa et al., 2025). Local wisdom can thus be defined as knowledge that is embedded within a community and serves as a reference in problem-solving, in accordance with the values, norms and the socio-cultural environment of that community (Naryatmojo, 2019). Education is the primary conduit through which local wisdom is transmitted to the younger generation. This transmission occurs through the integration of culture into the school curriculum, project-based learning, and the utilisation of digital technology for the documentation and dissemination of cultural knowledge.

This teaching method helps us connect with our rich cultural heritage while also inspiring new ideas that honor our traditional values, which are so important today. Embracing local culture can boost our pride and sense of belonging to our nation, encouraging everyone to take an active part in preserving our heritage. It is evident that traditional games, which are deeply rooted in local cultures, offer a practical and interactive medium for understanding Science, Technology, Engineering, Arts, and Maths (STEAM) concepts (Wicahyani et al., 2024). Despite their educational potential, these cultural elements are still underutilized in the contemporary curriculum. This study examines how traditional games can be integrated into STEAM learning to improve student learning outcomes and cultural awareness (Arztmann et al., 2023).

The integration of traditional knowledge with scientific concepts is congruent with contemporary pedagogical approaches such as STEAM, which combines science, technology, engineering, arts, and mathematics to provide a holistic learning experience (Revák et al., 2024). The integration of art, mathematics, technology, science, and engineering in this approach results in comprehensive, interdisciplinary, and creative learning. The integration of the five disciplines of STEAM, has been identified as an effective educational approach that encourages students to acquire skills relevant to the modern world (Sarwi et al., 2024).

STEAM encourages project-based learning and exploration, allowing students to apply theory in the real world, thereby fostering creative thinkers and future innovators (Mansur et al.,

2022; Shufa & Adji, 2024). Consequently, the STEAM approach is considered essential to equip students with the ability to deal with the problems of a changing world (Angreni et al., 2023; Meepat et al., 2024). The extant literature on STEAM learning predominantly concentrates on digital and technology-based methodologies, frequently overlooking the potential of local cultural practices. While certain studies have emphasized the utilization of arts and crafts in STEAM, there has been limited attention paid to traditional games as pedagogical instruments (Angreni et al., 2023; Jarwo et al., 2021; Syahrial et al., 2022). This study addresses this lacuna by exploring how traditional games can enhance STEAM learning and contribute to student development.

Despite the fact that a number of studies have been conducted on the integration of local culture into education, there is still a paucity of understanding of how traditional games can be systematically adapted into STEAM learning. For instance, research by (Cahyani et al., 2023) demonstrates the efficacy of traditional games in instilling character and cultural values in primary school students. In a similar vein, (Asip, 2023) underscores the significance of educational games (APE) in fostering child development. However, the emphasis remains constrained to cultural or pedagogical dimensions, with a paucity of integration with the STEAM approach. It is also emphasised in several other studies that the integration of local wisdom in science learning is conducive to the improvement of 21st-century skills (Kamila et al., 2024). However, these studies have not yet provided a comprehensive framework for the simultaneous integration of cultural elements with science, technology, engineering, arts and mathematics. This study is significant because it offers a novel perspective on the use of traditional games in South Sulawesi as a learning resource within STEAM education, thereby addressing gaps in previous research. In the Pangkep district, in particular, there is a scarcity of studies that specifically examine the role of traditional games in STEAM learning. The prevailing educational approaches in this area are rooted in a conventional curriculum that has not fully leveraged the potential of local culture as a learning resource. This study aims to address this research gap by exploring the potential of traditional games in the Pangkep district to enhance the effectiveness of STEAM learning. The findings of this study carry significant implications for educational practices, curriculum development, and cultural preservation efforts.

Firstly, from a pedagogical perspective, the integration of traditional games into STEAM learning has the potential to engender an authentic and contextual learning environment, thereby bridging abstract concepts with real-world applications in daily life. This pedagogical approach

facilitates the acquisition of scientific principles, mathematical reasoning, artistic expression, and engineering concepts through activities pertinent to local culture, thereby enhancing motivation and engagement in learning.

Secondly, in terms of curriculum innovation, the research findings emphasise the necessity to develop structured learning modules that systematically link traditional game activities with specific STEAM competencies. These modules have the capacity to be utilised across a variety of educational levels, thereby ensuring that traditional games do not merely function as supplementary activities, but rather, they are recognised as fundamental learning strategies that meet academic standards while concurrently reinforcing cultural identity.

Thirdly, with regard to teacher professional development, this research underlines the significance of specially designed training programmes, which are intended to furnish educators with the knowledge and skills required to adapt local cultural elements into modern pedagogical frameworks. The training programme encompasses lesson planning, the development of evaluation instruments, and the facilitation of collaborative learning that is grounded in cultural values.

Fourthly, from a policy formulation perspective, the findings of this study can be utilised by education policymakers at the regional and national levels to promote the formal integration of traditional games into school curricula. This step not only improves academic achievement but also ensures the sustainability of intangible cultural heritage.

From a cultural sustainability perspective, the findings of this research demonstrate that traditional games can function as dynamic cultural artefacts capable of adapting to educational needs without losing their historical value. hrough their application in STEAM learning, communities can strengthen intergenerational cultural transmission processes, foster a sense of ownership, and cultivate pride in local cultural heritage.

RESEARCH METHODS

This study employed a qualitative case study design, chosen for its ability to explore in depth the meanings, experiences, and potential of integrating traditional games into STEAM learning. A case study provides the opportunity to understand cultural practices within their specific contexts in a comprehensive manner (Creswell & Creswell., 2018)

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Research Site

The research was conducted in Pangkep Regency, South Sulawesi, a region known for preserving traditional games such as *Magasing-gasing*, *Gandrang Bulo*, and *Enggo-enggo*. The site was selected based on three key considerations:

1. Cultural vitality – traditional games are still actively practiced within communities.
2. Representation of Bugis-Makassar values – the games embody principles of *sipakatau* (mutual respect) and *siri'* (dignity).
3. Educational support – junior high school teachers in Pangkep have begun to create space for integrating local culture into classroom learning.

These factors make Pangkep a rich context for examining the intersection of local culture and STEAM pedagogy.

Participants

Participants were drawn from two groups:

1. Cultural experts (2), with deep knowledge of the history, meaning, and philosophical values of traditional games.
2. Junior high school teachers (5), teaching science, mathematics, and arts.

Participants were selected using purposive sampling, as they possessed relevant experience and expertise (Kin, Robert, 2018). The focus on junior high school teachers was intentional, as adolescence is a formative stage for developing creativity, logical reasoning, and collaboration through interdisciplinary approaches such as STEAM.

Data Collection

Data were gathered through three complementary methods:

1. Participatory observation – the researcher engaged directly in the games to understand their mechanisms, social interactions, and cultural meanings
2. In-depth interviews – semi-structured interviews with cultural experts and teachers (45–60 minutes) explored cultural significance and educational potential
3. Document and literature review – provided additional context and linked field findings to broader academic discourse.

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Data Analysis

Data were analyzed using thematic analysis (Braun & Clarke, 2006), involving familiarization, coding, theme development, reviewing, and narrative reporting. Each segment of data was mapped into two dimensions:

1. Content – STEAM elements embedded in the rules, tools, or mechanics of the games.
2. Impact – learning outcomes that emerged when the games were applied pedagogically.

For example, *Magasing-gasing* was mapped onto Science (rotation, force, energy), *Gandrang Bulo* onto Arts (rhythm, patterns, creativity), and *Enggo-enggo* onto Mathematics (strategy and logical patterns). To preserve authenticity, direct quotations from participants were used, such as a science teacher's remark: *"Students understand force and energy more quickly when they see the spinning top in action."*

RESEARCH RESULT

The identification of traditional games was achieved through data analysis, which revealed several traditional games with strong educational potential.

1. Gandrang Bulo (Art and Rhythm in STEAM Art Component)

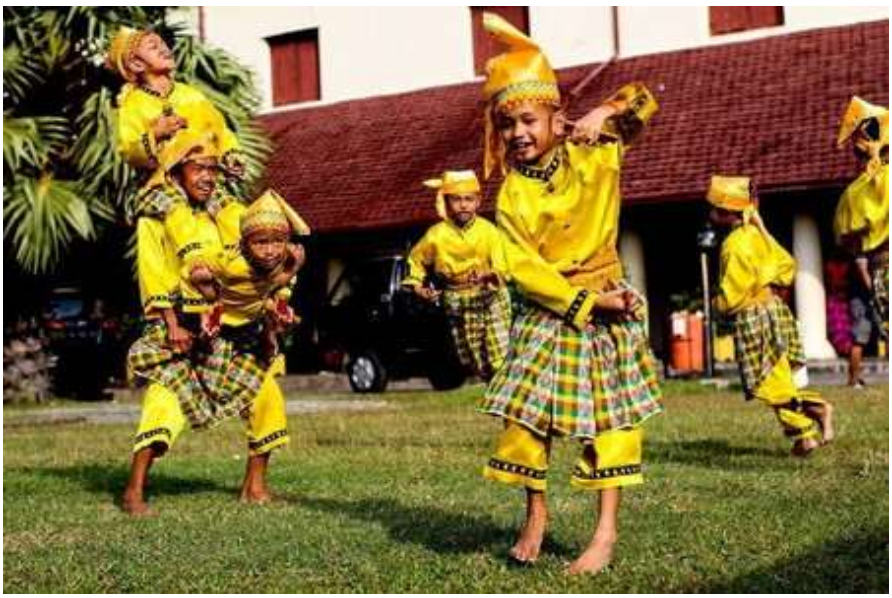

Figure 1. Gandrang Bulo Dance
(doc: TheAsian Parent: https://id.theasianparent.com/tari-gandrang-bulo)

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2. Magasing-gasing (Physics - Rotation and Momentum)

Figure 2. Magasing-gasing
(doc: Archipleago Ondinesai, 2024. https://archipelagoid.com/permainan-gasing-kebahagiaan-kegembiraan-disetiap-putaran/)

3. Enggo-enggo (Mathematics - Pattern Recognition and Strategy)

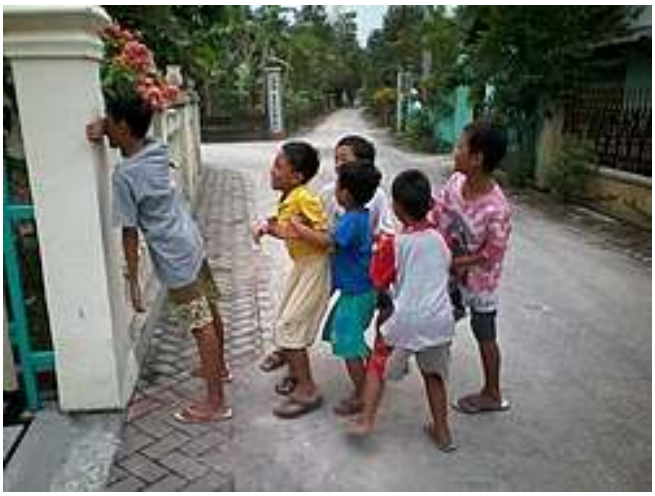

Figure 3. Enggo-enggo
(doc: wiki Buku, 2023)
https://id.wikibooks.org/wiki/Permainan_Tradisional_Sulawesi_Selatan/Enggo-enggo

The following games were identified as having educational potential: **Madende-dende, Macangke, Abaguli, Asangko-sangko Jangang, Mabboi-boi, Mallongga, Malari Tarompah (Motor Skills and Social Learning).**

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Figure 4. Madende-dende
(Sumber doc: Kareba nusa , 2023> https://www.karebanusa.com/2022/10/31/jjs-makassar-gelar-mtgf-lestarikan-permainan-tradisional-kepada-generasi-muda

Macangke

Figure 5. Macengke
(Sumber doc: Sulsel Herlad, 2024. https://sulsel.herald.id/2024/01/10/maccukke-permainan-tradisional-sulsel-terpopuler-sebelum-era-digital-yang-hanya-pakai-batang-kayu/

The findings of this study reveal that traditional games in South Sulawesi have considerable potential to be integrated into STEAM-based learning. Data were obtained through participatory observation in schools, in-depth interviews with teachers and local cultural experts, and a review of literature related to Bugis-Makassar cultural values. Thematic analysis was employed to identify the cognitive, social, motor, and cultural dimensions of each traditional game.

The analysis indicated that each traditional game contains STEAM aspects that can be grouped into two categories. The first is **content**, namely STEAM elements embedded in the rules, equipment, or mechanics of the game. The second is **impact**, referring to the learning outcomes

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that emerge when the games are used pedagogically. This framework allows the educational potential of traditional games to be explained more systematically, as illustrated in the following table:

Tabel 1. Educational potential of traditional games

Traditional Game	STEAM Aspects (Content – Intrinsic to the game)	STEAM Aspects (Impact – Learning outcomes when applied pedagogically)
Magasing-gasing (spinning top)	*Science*: Rotation, force, momentum, friction. *Technology*: Crafting techniques using wood/metal.	Facilitates students' understanding of force and energy; enhances engagement in science learning through direct observation.
Gandrang Bulo (bamboo percussion)	*Arts*: Rhythm, musical patterns, creativity. *Engineering*: Construction techniques using bamboo.	Develops collaboration and artistic expression; strengthens appreciation of local cultural identity.
Enggo-enggo (strategy game)	*Mathematics*: Pattern recognition, logic, strategy, counting moves.	Enhances critical thinking and problem-solving in mathematics.
Abaguli (traditional marbles)	*Science*: Potential and kinetic energy in motion. *Mathematics*: Estimation of angles and trajectories.	Promotes understanding of energy concepts while fostering accuracy and strategic thinking.

Field data strongly support this analysis. For example, *Magasing-gasing* was observed to help students connect directly with abstract scientific concepts. A science teacher explained, *"students understood more quickly because they could connect the spinning top with the lesson on force and energy in class."* Classroom observations confirmed this statement, as students eagerly discussed friction and momentum while watching the top spin and eventually slow down.

Similarly, *Gandrang Bulo* serves as a medium of art and cultural expression. Interviews with art teachers revealed high levels of student enthusiasm when playing bamboo percussion instruments, often creating their own simple rhythmic patterns. This activity not only enhanced musical creativity but also reinforced cultural identity, aligning with (Mulyani & Hapsari, 2024), who highlighted the role of oral literature and performance art in shaping cultural identity in South Sulawesi.

Mathematical dimensions emerged most clearly in *Enggo-enggo* and *Abaguli*. Students engaged in these games displayed logical reasoning, predicting outcomes, and calculating moves or angles to win. These findings correspond with (Kamila et al., 2024), who demonstrated that integrating local potential into science and mathematics learning strengthens students' critical thinking and cultural awareness.

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Meanwhile, *Malari Tarompah* highlighted the importance of teamwork and physical coordination. During observations, students were seen adjusting their steps in unison to successfully move forward on the wooden clogs. A local cultural expert emphasized that this game has historically functioned as a medium to cultivate solidarity within Bugis-Makassar communities. This resonates with Ni'am & Ferianto (2021), who showed that cooperative games can effectively strengthen social interaction among students.

Overall, the results of this study affirm that traditional games are not merely recreational activities but also embody educational dimensions that support science, technology, engineering, arts, and mathematics. These findings not only reinforce existing scholarship but also contribute novel insights by situating traditional South Sulawesi games within a STEAM framework. Nevertheless, it must be emphasized that this research remains at an exploratory stage. The scope of the study was limited to qualitative analysis through observation, interviews, and literature review, without empirical testing of effectiveness in classroom practice. Future research is therefore required to design and systematically test practical learning models based on traditional games in school contexts.

DISCUSSION

Impact on Student Learning

Cognitive Skills

It is evident that traditional games play a significant role in the enhancement of cognitive skills, particularly in the domain of understanding scientific concepts. In the Magasing-gasing game, for instance, students can learn physics principles such as rotation and momentum more realistically than in theory-based learning alone. By experiencing these phenomena directly, students not only memorise the concepts but also develop an understanding of their application in everyday life.

Enggo-enggo, for instance, has been shown to enhance mathematical aptitude, particularly in the domains of pattern recognition and problem-solving strategies (Hasan et al., 2024). The strategic element of the game fosters logical and analytical thinking, which is a foundational skill in mathematics. Students learn to calculate optimal moves to achieve victory, thereby indirectly developing an understanding of probability and strategic planning concepts.

Furthermore, the incorporation of traditional games into STEAM learning can serve to refine students' engineering skills.For instance, the game Mabboi-boi can be utilised to facilitate an

understanding of the concept of balance and simple structures. Additionally, it can teach students how weight distribution and fulcrum can affect the stability of an object, which is a fundamental concept in engineering.

Social and Motor Skills

Engagement in traditional games has been demonstrated to enhance cognitive abilities, in addition to cultivating students' social skills (Adipat et al., 2021; Ashar et al., 2024; Hartanto et al., 2021; Nadia Astarina et al., 2023). The nature of most traditional games is such that they are played in groups, a factor which has been shown to engender cooperation, communication and support among students A notable example is the Masobu-sobbu game, which necessitates coordination and strategic thinking to achieve victory, thereby fostering a sense of community and honing communication skills (**Masobu-sobbu).**

Furthermore, traditional games that demand active body movements, such as Macangke and Maddende-dende, have been shown to enhance students' motor skills (Salama & Ulpi, 2021; Syam, 2021). This activity has been shown to enhance balance, reaction speed, and agility. Consequently, traditional games emerge as a compelling alternative physical activity that is both enjoyable and advantageous for students' overall health and well-being. Furthermore, traditional games offer students the opportunity to comprehend the significance of cooperation and sportsmanship (Ariesta & Maftuh, 2020). A game such as Malari Tarompah, for instance, instructs students to collaborate with their teammates to achieve synchronised movement, instilling them with patience, coordination, and the capacity to assist each other in accomplishing a shared objective.

Cultural Awareness

Engaging students in traditional games has been demonstrated to have a dual impact, enriching their skills and strengthening their connection to cultural heritage (Shinta et al., 2019). In the current globalised era, digital games are increasingly becoming the preferred choice for children. In light of this, the integration of games within educational strategies has emerged as a pivotal approach to instilling cultural awareness while enhancing the contextualised and meaningful nature of the learning experience. This integration enables students to recognise their local games and comprehend the cultural values inherent within them.

Furthermore, traditional games have the capacity to influence cultural identity and engender a sense of pride in ancestral heritage.When students engage with Gandrang Bulo, they

acquire knowledge about the rhythm of traditional music and the significance of performing arts. This fosters an appreciation for the distinctiveness of local culture and cultivates a sense of connection to the traditions that have been handed down by preceding generations.

Challenges and Implementation Strategy

The challenges associated with integrating traditional games into the STEAM curriculum are numerous and significant. Despite the various benefits of traditional games in an educational context, their application in learning still faces many challenges. One of the main obstacles is the limited teaching materials that explicitly link traditional games with STEAM concepts. To date, many schools do not have comprehensive modules or guides that can support teachers in systematically integrating traditional games into learning. In addition, the lack of training for educators is a significant obstacle in the implementation of this strategy. A dearth of knowledge regarding local games, in addition to a lack of competencies in adapting them for effective learning methods, is a salient issue among educators.Without an in-depth understanding of pedagogical support, educators encounter significant challenges in optimising traditional games as learning tools that are relevant and aligned with curriculum demands.

A further challenge pertains to the limited time allocated for traditional games within the school curriculum, which often results in these games being regarded as supplementary activities rather than mandatory components of the curriculum. Consequently, many schools do not allocate space for these games in teaching and learning activities, thereby precluding students from maximising the benefits that these activities can offer.

The Strategy

The main step is to develop a curriculum that links traditional games with STEAM concepts. This curriculum should be systematically designed so that games are not just an entertainment activity, but also a tool to clarify science, technology, engineering, art and maths concepts in the curriculum. With this curriculum, teachers can more easily integrate traditional games into their learning. In addition, teacher training is very important to ensure effective implementation. Teachers need to be given a thorough understanding of how traditional games can support learning and how to adapt teaching methods to meet the needs of pupils. This training could include workshops, seminars or community-based training programmes involving cultural and educational experts.

Another strategic step is to work with cultural experts and local communities to preserve traditional games for educational purposes. Cultural communities can assist schools in documenting and adapting traditional games to keep them relevant to modern learning needs. This collaborative approach not only benefits education, but can also further strengthen local cultural preservation efforts.

CONCLUSION

This study, at an exploratory stage, identified the educational potential of traditional South Sulawesi games within the STEAM framework. Games such as *Magasing-gasing*, *Gandrang Bulo*, *Enggo-enggo*, and *Abaguli* were found to contain intrinsic STEAM elements and to foster learning outcomes when applied pedagogically. While the findings affirm their value in supporting scientific understanding, mathematical reasoning, artistic creativity, engineering skills, teamwork, and cultural identity, the study remains limited to qualitative analysis without classroom implementation. Further research is required to empirically test and develop practical models for integrating these games into STEAM education.

ACKNOWLEDGMENTS

The authors would like to thank the educators, students, and cultural practitioners who participated in this research. Their insights and experiences were invaluable in shaping the findings and recommendations of this study. It is also necessary to extend gratitude to the Muhamamdiyah Research and Development Council and the Muhamamdiyah University Parepare, the financial support for which was instrumental in facilitating this activity, with the 2025 Batch VIII Risetmu Grant being the specific funding source.

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