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The Myths in Sustainability Education navigator. Development, design, and use cases of an evidence-informed and accessible SE-mythology

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The Myths in Sustainability Education Navigator: Development, Design, and Use Cases of an Evidence-Informed and Accessible SE-Mythology

Abstract

Im Bereich der Bildung für nachhaltige Entwicklung können Mythen bedeutende (psychologische) Barrieren für effektives Lehren und Lernen darstellen. Der MYTHSE-Navigator (MYTHSE = Myths in and about Sustainability Education) ist ein dynamisches, digitales Bildungsmedium, das darauf ausgelegt ist, weitverbreitete fragwürdige Überzeugungen in der und über die Bildung für nachhaltige Entwicklung (z. B. „Nachhaltigkeit ist nur ein weiteres Thema, das einem überfüllten Lehrplan hinzuzufügen ist"; „Je gebildeter Menschen sind, desto nachhaltiger handeln sie") zu bündeln und zu entkräften (Lewandowsky et al., 2020). Er soll kritisches Denken fördern und Resilienz gegen Fehlinformationen stärken (van der Linden, 2023). Der MYTHSE-Navigator nutzt die Software Obsidian.md, um eine zugängliche, nachhaltige und evidenzinformierte SE-Mythologie (siehe Lilienfield et al., 2010) zu schaffen, d. h. eine vernetzte Sammlung von MYTHSE in Form eines OER-Wikis. Durch einen designbasierten Forschungsansatz (Anderson & Shattuck, 2012), der Literaturrecherche, Peer- und Experteninterviews sowie Nutzerfeedback umfasst, kategorisiert und entkräftet der Navigator MYTHSE mit strukturierten Widerlegungen (Schroeder & Kucera, 2022). Derzeit enthält er rund 18 MYTHSE und deren Widerlegungen. Vorläufige Ergebnisse deuten auf eine leichte Zugänglichkeit zu entkräfteten Mythen und ein erhöhtes Engagement von Lehrenden und Lernenden hin. Im Beitrag werden die Ziele, beispielhafte Inhalte und Anwendungsfälle dieses Bildungsmediums für die Bildung zur nachhaltigen Entwicklung vorgestellt und die potenzielle Rolle des Navigators bei der Förderung einer evidenzinformierten und kritisch reflektierenden Bildung für nachhaltige Entwicklung diskutiert.

Keywords: sustainability education, educational myths, open educational resource, educational media, Critical Thinking

1 Background and rationale for the *MYTHSE-Navigator*

Sustainability education (SE) plays a pivotal role in equipping educators and learners with the knowledge, skills, and attitudes necessary to address the grand challenges and wicked problems of our time. At its core, SE seeks to foster competences that enable individuals to think integratively and act responsibly for the benefit of society and the planet (e.g., Jones et al., 2010; Rieckmann & Muñoz, 2024). However, the effectiveness of SE and its

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transformative potential is often hindered by pervasive myths and misconceptions that create *psychological barriers* to (effective) teaching and learning.

Educational myths – widely held but incorrect beliefs about teaching and learning – are also problematic in the context of SE. Examples include assumptions such as "Sustainability education is merely environmental education" or "The more educated people are, the more sustainably they act" (see refutations by, e.g., Orr, 2004; Sterling, 2012). These myths may appear intuitive or plausible but are often at least questionable or even scientifically unsound (Lilienfeld et al., 2010; Sinatra & Jacobson, 2019). Rooted in cognitive biases, oversimplifications, and misinformation, such myths can harm educators, learners, and decision-makers by promoting ineffective practices, reducing engagement, and misdirecting or wasting resources (De Bruyckere et al., 2020; Lilienfeld et al., 2010).

Despite the increasing relevance of sustainability education (e.g., Jones et al., 2010; Rieckmann & Muñoz, 2024) and the growing interest in educational myths (e.g., De Bruyckere et al., 2020; Lilienfeld et al., 2010; Siegel, 2024a), the intersection of these two fields remains underexplored. While SE research has focused on pedagogy, content, and policy, and studies on educational myths have addressed their prevalence and impacts, a systematic approach to identifying and addressing SE-specific myths is still lacking.

The *MYTHSE-Navigator* (MYTHSE = Myths in and about Sustainability Education) was developed to address this critical gap as part of the *MYTHSE* research and practice project – an ongoing multi-study initiative. As a central outcome of this work, the Navigator is designed as a digital educational medium (Döbeli et al., 2018) and an open educational resource (OER) that is evidence-informed, dynamic, and accessible. It contributes to *transformative sustainability-oriented open education* (Algers & Wals, 2020) by equipping educators with tools to identify, understand, and challenge pervasive myths in sustainability education.

Its primary goal is to empower instructors with the knowledge and strategies necessary to facilitate transformative learning (Lotz-Sisitka et al., 2015). By promoting conceptual change (Vosniadou, 2013), fostering critical thinking (Haber, 2020), and strengthening mental immunity against misinformation (Norman et al., 2024), the Navigator enables educators to confront these misconceptions effectively.

One of the key challenges the Navigator addresses is the lack of structured, accessible resources for debunking SE myths. Existing materials are scattered across disciplines and formats, making it difficult for educators to find reliable, actionable information (Barth & Rieckmann, 2012). Moreover, many educators, particularly in higher education, face limited training in SE and often lack the confidence or knowledge to integrate it effectively into their teaching. The Navigator empowers educators by offering clear, research-based refutations, practical tools, and strategies to challenge myths and foster critical thinking (Brookfield, 2017; van der Linden, 2023).

The rationale for the Navigator also stems from the pressing need to "give facts a fighting chance" against misinformation (Winkler & Cook, 2024). The Navigator builds on conceptual change theory (Vosniadou, 2013) and inoculation[1] theory (Norman et al., 2024) to address misconceptions effectively. This proactive approach is vital in a time when misinformation and disinformation are pervasive.

1 Inoculation is a psychological technique that strengthens resistance to misinformation or persuasion by exposing individuals to a weakened form of an argument along with refutations, similar to a vaccine against misinformation (van der Linden, 2023)

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The *MYTHSE-Navigator* leverages the software *Obsidian.md* to create an accessible, sustainable, and evidence-informed SE-mythology (see Lilienfield et al., 2010), i.e., an interconnected collection of *MYTHSE* in the form of an OER-wiki. Through a design-based research approach (Anderson & Shattuck, 2012), incorporating literature review, peer and expert interviews, and user feedback, the navigator categorizes and debunks *MYTHSE* with structured refutations (Schroeder & Kucera, 2022). Currently, it contains 18 *MYTHSE* and their refutations.

This article is structured into two chapters. It begins with an exploration of the background and development of the *MYTHSE-Navigator* (2.1), followed by a description of its structure and key characteristics (2.2). Section 2.3 illustrates practical use cases and its application in (higher) education. The final chapter discusses strengths (3.1), weaknesses (3.2), and concludes with future perspectives (3.3).

2 Development and design of the *MYTHSE-Navigator*

2.1 Development

The *MYTHSE-Navigator* is being developed since 2022 at the University of St. Gallen (HSG) within the ongoing research and practice project *MYTHSE*, using a design-based research approach (Anderson & Shattuck, 2012) and gathering multiple forms of evidence from different *lenses* (Brookfield, 2017). Central to the development process are reflections of *critical incidents*, i.e., reflective moments when beliefs are challenged (Brookfield, 2017), encountered during teaching, research, and collaboration with colleagues. These incidents revealed the prevalence of questionable beliefs about sustainability education, including those held by myself.

- A scoping review of the sustainability education field helped map existing myths and identify areas requiring further investigation (article in preparation).
- An analytic-autoethnographic study (Anteliz et al., 2023; Chang et al., 2008) provided a personal lens, involving self-reflection and "confessions" (Mazur, 2009) about holding and overcoming misconceptions regarding sustainability education (article in preparation).
- A problem-centered expert interview study conducted via the *Sustainability Education Podcast* engaged international experts, collecting insights into common myths and strategies for addressing them (article in preparation).

A reflective journal maintained since May 2022, containing over 1,050 multimedia notes (textual but also multimedia [videos, infographics, hypertext] data), facilitated systematic data collection and organization using the "tool for thought" (Siegel & Lohner, 2024) *Obsidian*. The *MYTHSE-Navigator* integrates knowledge management principles (Siegel & Lohner, 2024) to systematically identify, create, share, and preserve teaching-related knowledge about sustainability education.

The Navigator's development is inspired by existing resources, particularly the volunteer-run *Skeptical Science* website (Skeptical Science, 2024; Winkler & Cook, 2024), which offers among others refutations of climate misinformation through a database-driven approach.

To identify, prioritize, and analyze potential *MYTHSE*, several instruments were developed, refined, and used during the process, including:

- *Heuristics for Identifying Myths:* Cognitive *rules of thumb* (e.g., beware of oversimplifications) to detect oversimplifications or other indicators of myths (Siegel, 2024a).
- *Mythbusting Decision Tree:* A framework for evaluating the prevalence, influence, and relevance of myths (Siegel, 2024b).
- *Educational Myths Refutation Canvas:* A structured template for prebunking and debunking myths in a detailed and replicable manner (Siegel, 2024a). Here, I follow a technocognitive approach, i.e. detecting and explaining fallacies (Zanartu et al., 2024) in *MYTHSE*.

These tools, all open educational resources, are integrated into the *MYTHSE-Navigator*, ensuring accessibility and adaptability. The development process continues to evolve, with a focus on refining features and incorporating feedback from ongoing use in teaching, research, and expert consultations.

2.2 Design: Structure & characteristics

The *MYTHSE-Navigator* is an open educational resource (OER) designed to empower instructors in identifying, understanding, and challenging misconceptions in and about sustainability education. It serves as an accessible, sustainable, and evidence-informed collection of refutations to educational myths aka SE-mythology (see Lilienfeld et al., 2010), structured as an interconnected wiki accompanied by various mythbusting tools and additional resources (see e.g. Skeptical Science, 2024).

Refutations are the backbone of the *MYTHSE-Navigator*. Refutations are in general texts containing counterarguments that have been shown to effectively disprove or debunk certain claims (Ferrero et al., 2020; Lewandowsky et al., 2020; Schroeder & Kucera, 2022). At its core, the Navigator is based on currently a database of 18 *MYTHSE* refutations adhering to the "fact-myth-fallacy-fact" structure, as recommended by psychological research (Lewandowsky et al., 2020; van der Linden, 2022). Following the educational myths refutation canvas (Siegel, 2024a), each refutation addresses key aspects of myths, such as their characteristics, causes, consequences, and ways to counter them. Examples range from quick debunks, like "Sustainability education is merely environmental education," to more detailed analyses. The refutations draw on best practices for debunking misinformation (Ferrero et al., 2020) and utilize tools like the *Educational Myths Refutation Canvas* (see section 2.1).

The Navigator also offers a curated toolkit to support educators in myth-busting efforts. This includes a glossary for relevant key terms, interactive infographics (e.g. Some Challenges of Challenging Educational Myths), podcast episodes, blog posts and literature recommendations for instance on educational psychological myths (Christodoulou, 2014; De Bruyckere, 2020; Lilienfeld et al., 2010).

Grounded in an emancipatory approach, the Navigator incorporates various tools (see section 2.1; Siegel, 2024a, 2024b) – all of which are open educational resources (OER). These curated tools enable users to systematically identify, analyze, and challenge myths, misconceptions, and questionable beliefs in sustainability education.

Designed for accessibility and usability, the Navigator offers multiple entry points for users: a structured starting page, an indexed list of myths, and dynamic tagging (e.g.

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refutation status, conclusion: myth, nuanced, fact). Bi-directional links between related arguments and key terms facilitate seamless navigation, fostering an interconnected learning ecosystem within MYTHSE. The platform is modularized and bite-sized, ensuring usability and adaptability for diverse audiences.
Grounded in contemporary insights on digital culture and educational media, the Navigator reflects the *shift in dominant media* from the printing press society to the information society (*Leitmedienwechsel*; Döbeli Honegger et al., 2018). It aligns with Stalder's (2018) concept of the *digital condition*, moving beyond basic media literacy to emphasize the societal implications of digitalization. To enhance engagement, the Navigator employs multimodal content (e.g. videos, infographics, hypertext) and assigns unique short-links to each myth and refutation, reinforcing addressability for efficient referencing and dissemination.

2.3 Use cases of the *MYTHSE-Navigator*

This chapter outlines a non-exhaustive selection of relevant, potential, and to a certain extent related use cases for the *MYTHSE-Navigator*. Designed as a flexible and adaptable tool, it supports a range of stakeholders and applications across educational and professional contexts. While the examples provided serve as suggestions, the Navigator itself offers an evolving collection of application scenarios.

2.3.1 Target groups

The *MYTHSE-Navigator* is designed to support diverse stakeholders in education and beyond. These include among others:

- *Educators (especially in higher education)* aiming to challenge misconceptions in sustainability education and promote evidence-informed practices.
- *(Educational) Researchers and curriculum developers* addressing pervasive myths in sustainability education through analysis and innovation.
- *Students (in education-related disciplines)* seeking resources to enhance critical thinking skills and resilience against misinformation.
- *(Education) Policy makers* leveraging structured insights into educational myths for policymaking.

2.3.2 Applications in teaching and learning in (higher) education

The *MYTHSE-Navigator* can be employed in various educational activities and contexts, such as:

- *Lesson Planning & Curriculum Design:* The Navigator can enable educators to design evidence-informed lessons and curricula by using the existing refutations of common *MYTHSE* – gaining inspiration from worked examples (Renkl, 2021).
- *Misconception-Based Teaching Approaches:* By promoting strategies like prebunking and debunking (Lewandowsky et al., 2020; van der Linden, 2023), the Navigator supports teaching approaches that explicitly address misconceptions. This includes refutational or agnotology-based teaching (Cook et al., 2014), where educators strategically and explicitly use misconceptions as learning opportunities and catalysts to foster more sustainable learning.

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- *Critical Thinking Development:* The Navigator can enhance critical thinking (Haber, 2020) and *mental immunity* (Norman et al., 2024) – a certain degree of resilience to false, or even dangerous ideas in (sustainability) education. It equips users with resources to evaluate arguments critically and systematically, focusing not only on *what* to think but also on *how* to think.
- *Self-Reflection and Intellectual Humility:* The Navigator fosters critically reflective teaching (Brookfield, 2017), encouraging educators to scrutinize their assumptions and beliefs. It also promotes intellectual humility (Porter et al., 2022), inspiring educators and students alike to question biases, fallacies and reflect on their own understanding. By facilitating self-reflection, the Navigator helps users identify questionable beliefs, which are often easier to detect in others (Pennycook et al., 2015).
- *Self-Study and Professional Development:* With its asynchronous and open format, the Navigator enables users to explore myths and refutations at their own pace. It serves as a comprehensive digital resource for self-directed learning, deeper exploration of specific topics, and literature-based inquiry. Users can analyze myths' characteristics, causes, consequences, and remedies while honing their mythbusting competencies.
- *Learning Transfer and Practical Application:* Emphasizing an emancipatory and transfer-oriented approach, the Navigator provides tools, worked examples (Renkl, 2021), and strategies to connect theory and practice (Anderson & Beavis, 2020). It aims to empower its users to apply effective strategies in real-world contexts, including dealing critically-constructively with *MYTHSE* and their *spreaders*. By fostering sustainable learning and practical knowledge application, the Navigator can enhance professional practice and promotes actionable insights.

3 Discussion

3.1 Strengths and contributions

The *MYTHSE-Navigator* demonstrates several key strengths that position it as an innovative tool for advancing sustainability education. It is grounded in findings derived from multiple evidence-based perspectives, ensuring a robust and multifaceted foundation (Brookfield, 2017). Its dynamic, interactive, and accessible format offers learners a variety of entry points, catering to diverse needs and contexts. Designed as an Open Educational Resource (OER), the Navigator has the potential to play a pivotal role in fostering evidence-informed and critically reflective education by addressing misconceptions and promoting both prebunking (van der Linden, 2023) and debunking (Lewandowsky et al., 2020).

The Navigator's broad applicability further amplifies its utility, extending beyond the classroom, to professional development of faculty or to informal learning environments. By systematically addressing educational myths, it empowers educators and learners alike to develop critical thinking skills (Haber, 2020) and build mental immunity (Norman et al., 2024) against *MYTHSE*, contributing to a more evidence-informed and reflective approach to sustainability education.

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3.2 Challenges and limitations

While the *MYTHSE-Navigator* offers significant promise, it also faces some notable limitations inherent to its current developmental stage. As a prototype and proof-of-concept, the Navigator remains a work in progress. The development process is highly time-intensive, requiring extensive conceptual work, systematic literature searches, detailed myth refutations, all of which demand substantial effort and resources.

Additionally, the project is susceptible to biases and credibility risks, particularly during its initial phases and due to being a project of one research. Despite systematic documentation and conceptualization, the Navigator's construction can feel somewhat disorganized due to its evolving nature (Law, 2007). Its dynamic structure necessitates regular maintenance and updates to remain accurate and relevant, adding further complexity to its long-term sustainability.

Understanding and effectively using the Navigator and its refutations also requires foundational knowledge in, for instance, sustainability, education or psychology, which may pose challenges for some users.

Furthermore, the Navigator currently predominantly employs passive inoculation strategies, offering refutations rather than engaging learners in creating their own myth analyses. This limitation highlights a missed opportunity to incorporate active inoculation (where users actively create *MYTHSE* themselves and learn about the techniques that underlie them) and experiential inoculation (where users are deliberately misled and then shown how it happened), which have been shown to enhance critical thinking and resilience (Trecek-King & Cook, 2024; van der Linden, 2023). Addressing these challenges will be crucial for optimizing the Navigator's utility and impact.

3.3 Future directions and concluding thoughts

The *MYTHSE-Navigator's* future directions focus on expanding its scope, enhancing accessibility, and refining its utility for diverse audiences (e.g. novices, experts). A key priority is the continuous improvement of the Navigator by broadening its database of refutations and further refining their clarity and depth.

Current research focuses on the categorization of MYTHSE according to the heuristic framework (see Figure 1), which integrates three core conceptual models: the *didactic triangle* (Comenius, 2022/1657), emphasizing the interplay between teachers, students, and content; *constructive alignment* (Biggs, 2014), highlighting the coherence between learning outcomes, activities, and assessments; and a *multilevel model of academic development* (Brahm et al., 2016), which situates myths within systemic layers of education, from universities to courses. This integrative approach enables a nuanced understanding of how myths manifest and operate across different educational contexts, informing targeted interventions to promote evidence-informed sustainability education.

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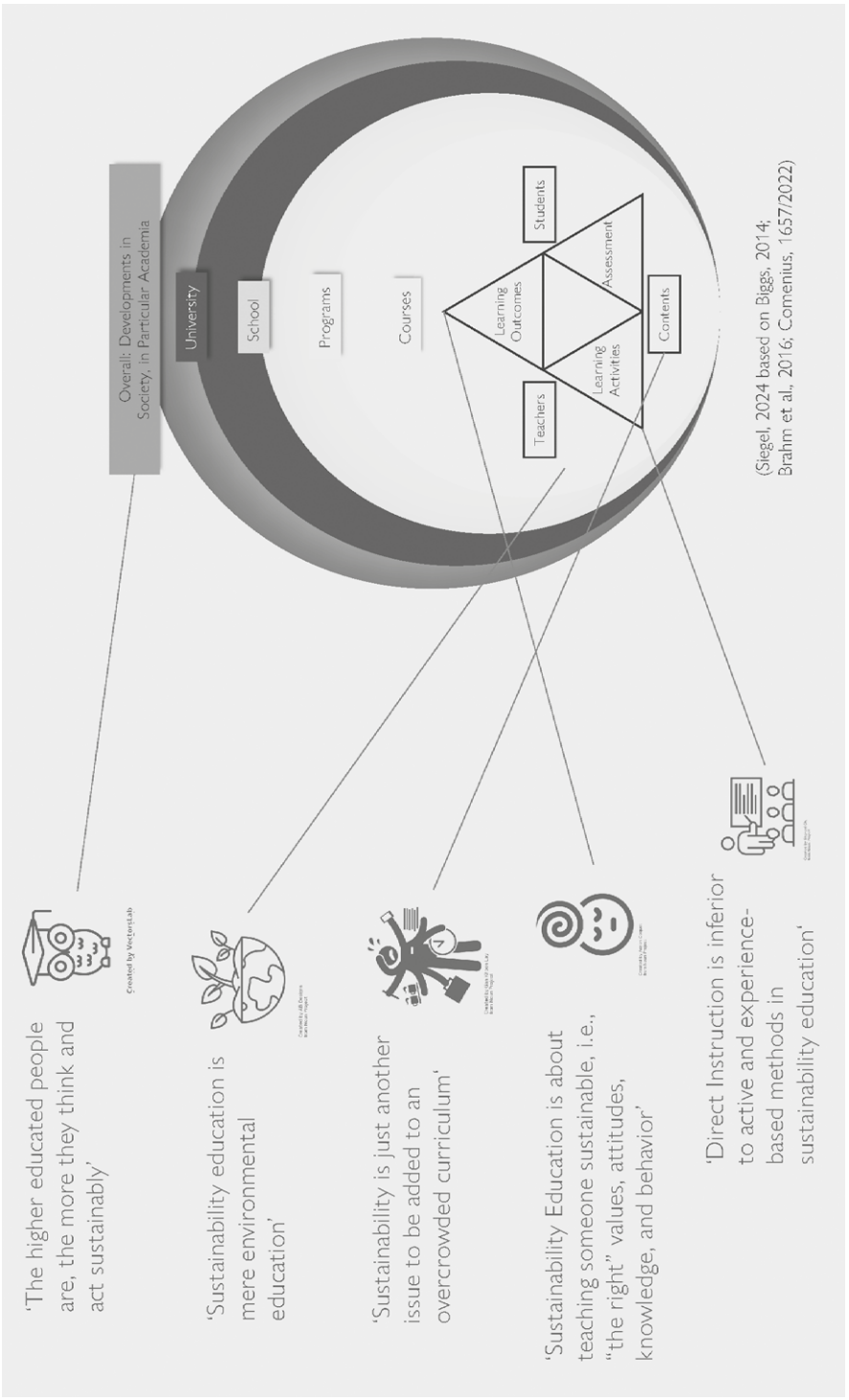

Fig. 1: Heuristic conceptual framework for categorizing MYTHSE (own research)

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Leveraging machine learning and generative artificial intelligence – such as large language models – to (semi-)automatically detect and classify questionable sustainability education-related arguments, identify logical fallacies, and assist in debunking myths offers promising avenues for innovation (see Zanartu et al., 2024, for research on climate science myths). Further enhancements could include an AI-supported chatbot (Alemdag, 2023; Kuhail et al., 2023) integrated within the Navigator, providing interactive guidance, personalized learning experiences, and easier navigation. By adopting these strategies, and by advancing ongoing projects such as a scoping review and an expert interview study of the MYTHSE project, the *MYTHSE Navigator* aims to solidify its role as a dynamic, evidence-based, and impactful OER in sustainability education (Algers & Wals, 2020). To achieve international reach, exploring high-quality AI-supported translations is essential, enabling users across linguistic contexts to access the resource.

All in all, the *MYTHSE-Navigator*[2] represents a significant step forward in addressing the myths in and about sustainability that hinder the effective and needed transformation of teaching practices, institutional processes, and societal transformation. By offering an evidence-based, dynamic, and accessible tool, the Navigator empowers educators, policymakers, and learners to critically engage with misconceptions and integrate robust refutations into teaching practices. Beyond its immediate applications, the Navigator contributes to establishing a new strand of research (Zawacki-Richter & Anderson, 2014), providing insights into the landscape of educational myths and advancing the theorization of sustainability education.

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