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How Can AI-Enhanced Case-based Learning Improve Problem-Solving in Cyberbullying Education? : A Literature Review

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Abstract: Cyberbullying poses a significant challenge to students' psychological well-being, academic success, and social interactions. Traditional educational models struggle to equip students with the problem-solving skills to address this issue effectively. Existing research highlights the benefits of case-based learning (CBL) in developing problem-solving, yet little is known about how AI-enhanced CBL can specifically support cyberbullying education. This study conducts a literature review to analyze the potential of AI-enhanced CBL in strengthening students' problem-solving skills in cyberbullying scenarios. Using a thematic synthesis approach, relevant studies from 2020 to 2025 were reviewed, focusing on AI applications in cyberbullying education, the effectiveness of CBL in fostering problem-solving skills, and AI-enhanced CBL's role in improving student problem-solving. Findings indicate that AI-enhanced CBL offers interactive case simulations, real-time feedback, and adaptive learning pathways, leading to improved analytical reasoning and decision-making in cyberbullying situations. Integrating AI, particularly large language models like ChatGPT-4, enhances engagement and scalability while fostering problem-solving skills. These insights have significant implications for educators, policymakers, and researchers seeking to implement AI-driven learning models that prepare students for the complexities of digital interactions.

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Introduction

Problem-solving skills are essential for students to navigate the complexities of modern digital interactions, especially in addressing challenges like cyberbullying. Cyberbullying is a prevalent issue that negatively impacts students' psychological well-being, academic performance, and social relationships (Weigle & Shafi, 2024). Research by Frensh et al. (2021) found that 856 students reported increased depression, 543 experienced decreased self-esteem, and 121 exhibited suicidal tendencies due to cyberbullying incidents. Additionally, a report by Seitz (2024) revealed that 41% of children develop social anxiety, 37% experience depression, and 26% have suicidal thoughts as a result of online harassment.

As cyberbullying continues to evolve in complexity, traditional educational models often struggle to equip students with the problem-solving skills needed to navigate and resolve online conflicts effectively (Cook, 2024). A study by Asriani et al. (2021) revealed that 59.9% of parents reported their children had been victims of cyberbullying, with social media (19.2%)

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and online gaming (7.9%) being the most common platforms for harassment. These findings highlight the pressing need for educational strategies that empower students to recognize, respond to, and prevent cyberbullying in an increasingly digital world.

Case-based learning (CBL) is a dynamic instructional model that strengthens students' problem-solving skills by engaging them in real-world scenarios that demand problem-solving and decision-making (Yang et al., 2024). Integrating artificial intelligence (AI), adds a new dimension to this model by offering interactive case simulations, real-time feedback, and personalized guidance. By leveraging AI-enhanced case-based learning, students can analyze complex cyberbullying cases, develop strategic responses, and refine their decision-making skills. This combination not only enhances their problem-solving skills to address cyberbullying effectively but also fosters greater independence and adaptability in digital problem-solving (Bruen et al., 2024).

Extensive research on case-based learning (CBL) underscores its effectiveness in cultivating students' problem-solving skills. Miftah et al. (2024) found that students engaged in interactive case-based learning (ICBL) exhibited remarkable improvements in problem-solving skills, spesifically in diagnosing problems and devising effective solutions compared to those taught through conventional methods. Likewise, Astuti et al. (2024) emphasized that CBL fosters problem-solvingand sharpens analytical skills, making it a powerful pedagogical model. J.-S. Kim & Choi (2021) highlighted CBL's significant impact on problem-solving skills, self-directed learning, and academic self-efficacy, reinforcing its role in student empowerment. Additionally, Gholami et al. (2021) suggested that applying CBL through multi-episode cases provides an engaging and structured model to enhancing students' perceived problem-solving skills and learning motivation. These findings affirm CBL's transformative potential in education, positioning it as an essential strategy for fostering problem-solvinglearners.

Despite the growing interest in AI-enhanced learning, little research has explored how AI-enhanced case-based learning (CBL) can specifically strengthen problem-solving skills in cyberbullying education. Most AI-focused studies in education emphasize automation, assessment, or tutoring systems rather than interactive, problem-based learning (Schiff, 2022). By integrating ChatGPT-4's advanced language processing capskills, students can engage with AI-enhanced case studies that simulate real-world cyberbullying scenarios, challenging them to analyze situations, develop strategies, and refine their decision-making skills (Koyuturk et al., 2024).

This study addresses this gap by exploring how AI-enhanced case-based learning (CBL) enhances students' problem-solving skills to navigate and resolve cyberbullying situations. What sets this research apart is its focus on AI not just as a tool, but as an active facilitator of structured problem-solving exercises. By engaging with AI-enhanced case studies, students can practice, refine, and strengthen their problem- in a dynamic, interactive learning environment.

AI-enhanced case-based learning (CBL) offers a promising model to improving cyberbullying education by strengthening students' problem-solving skills. Its development and implementation provide valuable insights for educators, institutions, and researchers. For educational institutions, AI-enhanced CBL can serve as a framework for equipping students with the problem-solving skills needed to address cyberbullying effectively. Meanwhile, researchers can use this study as a foundation for further exploration into AI-enhanced learning models. This research explores how AI-enhanced CBL is designed to develop problem-solving

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skills, the AI-enhanced models and technologies used in cyberbullying education, and its impact on students' problem-solving skills to analyze and resolve cyberbullying cases.

Research Method

To explore how AI-enhanced case-based learning (CBL) improves problem-solving skills in cyberbullying education, a comprehensive literature review was conducted. This review synthesizes research on AI applications in cyberbullying, the impact of CBL on students' problem-solving skills, the impact of AI-enhanced case-based learning model on students' problem-solving skills, and best practices for integrating AI into cyberbullying education. Relevant studies were sourced from academic databases, including Google Scholar, Scopus, Springer, ScienceDirect, Tandfonline and Semantic Scholar, using keywords such as "AI in education," "Case-based Learning," "problem-solving in education," "AI-assisted learning," "ChatGPT in education," and "cyberbullying prevention through learning."

The selection process prioritized publications from 2020 to 2025, focusing on AI-enhanced CBL that contribute to problem-solving skills development. To ensure a well-rounded analysis, both qualitative and quantitative studies were included, ranging from experimental research to systematic reviews and meta-analyses. Articles were initially screened based on titles and abstracts, followed by a full-text review to assess relevance.

Thematic synthesis was used to analyze the data, highlighting key themes such as AI-enhanced CBL, the effectiveness of CBL in fostering problem-solving skills in AI-enhanced case studies. A comparative analysis further examined the role of different AI applications, including ChatGPT-4 and other generative AI models, in shaping case-based learning experiences. By synthesizing these insights, this review provides a comprehensive understanding of how AI supports the development of problem-solving skills in cyberbullying education. The findings offer valuable guidance for educators, policymakers, and researchers in designing AI-enhanced learning models that equip students with the problem-solving skills needed to navigate digital challenges effectively.

Result and Discussion

This section presents key findings from the literature review, highlighting the role of Artificial Intelligence (AI) in cyberbullying education and the impact of case-based learning (CBL) on students' problem-solving skills. By synthesizing previous research, this analysis explores how AI-enhanced CBL fosters problem-solving when addressing cyberbullying cases. The findings are structured into three main areas: (1) AI applications in cyberbullying education, (2) the influence of CBL on problem-solving development, and (3) the effects of AI-enhanced CBL on students' ability to navigate and resolve cyberbullying incidents. The following tables provide a detailed summary of key research insights within each category.

Table 1. Review of Research "AI Applications in Cyberbullying Education"

Author(s) & Year	Research Objectives	Methods	Key Findings	AI Tools in Cyber-bullying Education
Cirillo et al. (2025)	To evaluate LLMs on binary and	Comprehensive exploration of a large number of	High performances of LLMs, particularly Claude	Claude, Mistral, ChatGPT,

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	multiclass classification tasks on thousands of real posts, and also compare their performance with 24 machine learning and natural language processing models.	models to correctly evaluate and identify the most effective approach to be used for specific problems, such as cyberbullying detection.	3.0 and Mistral family models, in identifying different types of cyberbullying. The domain expert evaluation of explainability showed that LLMs belonging to the Claude and Mistral families had better scores.	Command R+, Copilot, Dolly 2.0, Falcon-40b, Gemini, Llama, Qwen, Solar
Kumar et al. (2024)	To investigate the effectiveness of AI models for detecting bias and cyberbullying.	Semantic analysis, feature engineering, and transformer-based AI models trained on real and synthetic cyberbullying data.	ChatGPT-4o mini effectively detects and mitigates both cyberbullying and bias with high accuracy using transformer models and synthetic data.	ChatGPT-4, Pi AI, Claude 3 Opus, and Gemini-1.5
Mendoza-Pinto (2023)	To develop and evaluate a ChatGPT-integrated Telegram chatbot for emotional support and bullying reporting.	Exploratory and descriptive approach with chatbot development, integration, and testing.	The chatbot provided basic emotional support, improved response consistency with ChatGPT, enabled intuitive interaction via Telegram.	ChatGPT-integrated chatbot
Ottosson (2023)	To enhance the research on cyberbullying detection models	Quantitative approach by fine-tuning a GPT-3 Ada model and evaluating its performance.	Fine-tuned GPT-3 Ada performs well in cyberbullying detection, achieving high accuracy but with higher latency than traditional ML models.	GPT-3 Large Language model

The reviewed studies highlight the growing role of AI in cyberbullying education, focusing on detection, bias mitigation, and emotional support (Table 1). Cirillo et al. (2025)

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found that LLMs, particularly Claude 3.0 and Mistral models, excel in identifying cyberbullying across X, Facebook, and Reddit, outperforming 24 traditional models in accuracy and explainability. Kumar et al. (2024) demonstrated that ChatGPT-4o mini effectively detects and mitigates cyberbullying and bias using transformer models trained on real and synthetic data. Mendoza-Pinto (2023) developed a ChatGPT-integrated Telegram chatbot that enhances emotional support and reporting consistency. Ottosson (2023) fine-tuned a GPT-3 Ada model for cyberbullying detection, achieving high accuracy but with increased latency. AI, particularly LLMs and transformer-based models, has proven effective in cyberbullying detection and mitigation. Chatbots further support victims, while fine-tuning improves accuracy despite latency concerns. Future research should address efficiency and ethical considerations in AI-driven moderation.

Table 2. Review of Research "The Impact of Case-based Learning on Problem-solving Skills"

Author(s) & Year	Domain of Knowledge	Methods	Key Findings on The Impact of CBL on Problem Solving
Mustaji et al. (2024)	Educational Technology	Questionnaire survey and focus group discussions.	Students perceive case-based learning as effective in enhancing problem-solving skills.
Irwanto et al. (2024)	Chemistry	Quasi-experimental design. A problem-solving assessment using an essay.	The implementation of case-based learning proved effective in bolstering students' problem-solving skills.
Diningrat et al. (2024)	Educational Technology	Quasi-experimental study with non-equivalent control groups and a pre- and post-test.	Learning through the flipped classroom combined with CBL resulted in better problem solving skills compared to the flipped classroom model and conventional method.
Mutawakkil (2024)	History	Literature review	Case-based history learning is effective in developing students' research and problem-solving skills.
Miftah et al. (2024)	Mathematics	Quasi-experimental design, an experimental group and a control group.	Students instructed using the interactive case-based learning model demonstrated superior complex mathematical problem-solving skills compared to control group.
Tran & Thai (2023)	English Communication	Qualitative study, conducting	The instructors perceived CBL as an effective pedagogical

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		interviews with the instructors.	method that enhances problem-solving.
Alani & Grewal (2023)	Industrial Biotechnology	Pedagogical study, an anonymous survey questionnaire.	The effect of CBL on problem-solving skills with 62% of the students having agreed (42% agreed and 20% strongly agreed), and 38% of the students with a neutral viewpoint.
J.-S. Kim & Choi (2021)	Nursing	Quantitative study with self-report questionnaire before and after case-based learning.	This study suggested the need for various learning programs such as case-based learning to improve students' problem-solving skills.
Gholami et al. (2021)	Nursing	Quasi-experimental, within-subjects, pretest-posttest design.	CBL method applied through multi-episode cases is an effective model to improving the perceived problem-solving.

Research on AI-enhanced Case-Based Learning (CBL) demonstrates its potential to improve problem-solving skills, engagement, and instructional effectiveness across various disciplines (Table 3). Ennab et al. (2025) highlighted that generative AI enhances CBL by increasing learner engagement and scalability. Luke et al. (2024) found that while ChatGPT-3.5 performed well on lower-order cognitive tasks, ChatGPT-4 showed greater accuracy in clinical case applications, particularly in biochemistry. Sauder et al. (2024) reported that AI can effectively generate and respond to case-based learning scenarios but struggles with complex topics. Thanasi & Mema (2024) emphasized AI's transformative potential in mathematics education, advocating for adaptive instructional practices. Farber (2024) demonstrated that AI-assisted decision-making benefits legal education but requires structured implementation for optimal impact. AI-enhanced CBL offers significant advantages in improving problem-solving skills and engagement, with its effectiveness varying based on domain and implementation strategy. While AI shows promise in supporting case analysis and reasoning, its limitations in handling complex concepts highlight the need for guided integration in education.

Table 3. Review of Research "The Impact of AI-Enhanced Case-based Learning Model on Students' Problem-Solving Skills"

Author(s) & Year	Domain of Knowledge	Methods	Key Findings on AI-Enhanced CBL
Ennab et al. (2025)	Medical Education	Scoping review, Arksey & O'Malley framework, PRISMA-ScR	Generative AI enhances Case-based Learning by improving problem-solving skills, learner engagement, and scalability.

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Luke et al. (2024)	Physiology and Biochemistry	Comparative analysis, GPT-3.5 vs. GPT-4, case-based learning questions independent grading	ChatGPT-3.5 performed well on lower-order cognitive tasks, it struggled with applying physiological and biochemical concepts in clinical cases. ChatGPT-4 showed improved accuracy, particularly in biochemistry, highlighting the evolving capability of AI.
Sauder et al. (2024)	Medical Education	GenAI, such ChatGPT is explored by evaluating its performance in engaging in clinical reasoning by prompting it to respond to a case-based learning scenario.	GenAI has the ability to answer questions, generate test questions, and appropriately respond to prompts in case-based learning scenarios. It performed well in addressing prompts related to epidemiology, diagnosis, and treatment but struggled to generate information on complex topics.
Thanasi & Mema (2024)	Mathematics Education	Case study methodology. The study deeply analyzes the implementation and impacts of AI tools in classrooms by examining specific cases.	AI presents opportunities for transformative advancements in mathematics education. Embracing these opportunities and adapting instructional practices accordingly will empower educators to foster more effective and personalized learning experiences for their students.
Farber (2024)	Legal Education	Case study methodology with a quasi-experimental design, comparing AI-enhanced and traditional digital learning in a criminal law course through student surveys and performance evaluations.	AI-assisted decision-making in case analysis positively impacts students' problem-solving skills, but its effectiveness depends on structured implementation and proper student guidance.

The combination of AI and Case-based Learning (CBL) transforms education by enhancing problem-solving skills and learner engagement. In cyberbullying education, AI improves detection, mitigation, and emotional support, fostering safer digital spaces. Across disciplines, AI strengthens CBL's effectiveness, scaling its benefits while encouraging

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problem-solving. Despite these advantages, structured implementation remains essential to address AI's limitations in complex scenarios and ensure its meaningful integration in diverse educational contexts.

Figure 1. Integration of AI-Enhanced Case-Based Learning in Cyberbullying Education: Application, Impact, and Implications for Problem-Solving

Best Practices For AI-Enhanced Case-based Learning Improve Problem-Solving in Cyberbullying Education

The integration of AI in case-based learning (CBL) offers a transformative approach to cyberbullying education, enabling students to recognize, analyze, and develop solutions to real-world cyberbullying incidents. AI, particularly large language models (LLMs) such as ChatGPT-4, Claude 3.0, and Mistral, enhances the learning process by providing real-time insights, adaptive feedback, and automated evaluation. The following six-stage framework outlines best practices for implementing AI-enhanced CBL in cyberbullying education.

1. **Case Selection and Data-Driven Contextualization**

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Effective AI-enhanced CBL begins with selecting real-world cyberbullying cases that reflect current trends and challenges. AI can assist in gathering, classifying, and analyzing large datasets of cyberbullying incidents from platforms like Facebook, X (Twitter), and Reddit (Cirillo et al., 2025; Kumar et al., 2024). LLMs such as Claude 3.0 and Mistral demonstrate high accuracy in detecting various cyberbullying patterns, ensuring that selected cases align with authentic digital experiences. Teachers can leverage AI-generated case studies to provide students with realistic scenarios that highlight the emotional, legal, and social dimensions of cyberbullying.

2. **Problem Identification and Role-Based Interaction**
   In small groups, students discuss key issues such as the social and emotional impact of cyberbullying. AI enhances this process by facilitating role-based simulations where students engage as victims, perpetrators, or bystanders (Luke et al., 2024; Sauder et al., 2024). AI-driven role-playing assistants allow learners to experience multiple perspectives, fostering empathy and problem-solving. Additionally, ChatGPT-4 provides guiding questions and prompts to deepen discussions, ensuring that students analyze the nuances of cyberbullying incidents from various viewpoints.
3. **Independent Investigation and AI-Assisted Exploration**
   Students conduct independent research on cyberbullying policies, ethical considerations, and prevention strategies. AI serves as a digital facilitator, offering interactive explanations and curated information to support students' exploration. Transformer-based models, such as those examined by Kumar et al. (2024), enable AI to detect biases in online interactions and suggest countermeasures. Additionally, ChatGPT-4 assists students in navigating legal frameworks and psychological studies related to cyberbullying, enriching their understanding with evidence-based insights.
4. **Collaborative Problem-Solving and AI-Driven Feedback**
   After gathering data, students collaborate to develop comprehensive solutions. AI enhances this phase by providing analytical feedback on the feasibility and effectiveness of proposed interventions. Adaptive AI feedback systems, as demonstrated by Farber (2024) in legal education, improve students' decision-making processes by evaluating case-based arguments. Similarly, Mendoza-Pinto (2023) found that AI chatbots facilitate reflective discussions, allowing students to refine their problem-solving strategies based on structured AI-driven assessments.
5. **Solution Presentation and Interactive AI Evaluation**
   Students present their solutions to peers and instructors, receiving AI-generated evaluations alongside human feedback. AI can simulate real-world implementation scenarios, predicting potential outcomes of proposed solutions (Thanasi & Mema, 2024). Instructors can use AI to generate alternative case variations, encouraging students to adapt their strategies to different contexts. AI-assisted decision-making tools, as explored in medical education by Sauder et al. (2024), ensure that students critically assess the strengths and limitations of their approaches before finalizing their solutions.
6. **Reflection, Adaptive Assessment, and Continuous Learning**
   The final stage involves self-reflection, where students analyze their learning process and problem-solving effectiveness. AI-powered self-assessment tools provide personalized feedback, identifying areas for improvement. Research by Kim & Choi (2021) highlighted that AI-driven reflection enhances students' awareness of their

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problem-solving strategies, leading to improved learning outcomes. Furthermore, AI can track students' progress across multiple cases, adapting future learning experiences to address gaps in understanding.

Discussions

Based on empirical findings, large language models (LLMs) such as Claude 3.0 and ChatGPT-4 show significant effectiveness in detecting, mitigating, and providing emotional support related to cyberbullying through interactive case simulation and adaptive feedback (Cirillo et al., 2025; Kumar et al., 2024). These successes align with Vygotsky's Scaffolding Theory, where AI is a dynamic support tool within the Zone of Proximal Development (ZPD). The fading mechanism - a gradual reduction of support as student independence increases - is a modern extension of this concept, strengthening students' analytical skills in complex contexts (Puntambekar, 2022) such as cyberbullying. Although not originally designed for education, AI can now identify critical aspects of learning tasks and help expert players (e.g., in strategy games such as chess and Go) optimize their ZPD, as Sætra (2022) explains.

Furthermore, the adaptation of four types of digital scaffolding from Suwastini et al. (2021)-procedural (interface guidance), conceptual (language/emotion pattern identification), metacognitive (critical reflection), and strategic (support adjustment)-allows AI to act as a companion for cyberbullying case analysis. AI-based interactive simulations also reinforce Bandura's Social Cognitive Theory, whereby observation of digital behavioral 'models' increases students' self-efficacy, i.e. confidence in dealing with cyberbullying situations through iterative practice and real-time feedback (Khan et al., 2024; Basri, 2024).

AI-enhanced case-based learning integrates constructivist principles, aligning AI tools with pedagogical frameworks to modernize education. Studies show that AI-CBL boosts problem-solving skills via personalized, adaptive learning grounded in real-world interactions (Gaitantzi & Kazanidis, 2025). Istrate & Velea (2024) highlights AI's role in fostering collaboration and interactivity, aligning with constructivist values. Wang et al. (2025) links AI-driven models (e.g., large language models) to enhanced critical thinking, while Guo et al. (2024) emphasizes generative AI's capacity to nurture creativity, ethics, and lifelong learning through tailored experiences. M. Kim & Adlof (2024) positions ChatGPT as a supportive tool—not a replacement—in student-centered constructivist environments. Together, these findings confirm that AI-enhanced, constructivist-aligned methodologies provide current, systematic solutions to educational challenges, balancing theory and practice.

Integrating adaptive learning with advanced AI and machine learning in e-learning environments has emerged as a groundbreaking approach to reshape traditional educational models by leveraging data-driven personalization, timely feedback, and dynamic content delivery to optimize individual learning outcomes. Recent empirical studies reveal that AI-enhanced learning systems can automatically adjust the level of case difficulty based on students' abilities—thus fulfilling the core promise of adaptive learning (Thanasi & Mema, 2024). Strielkowski et al. (2024) argues that such systems harness intelligent algorithms to offer tailored content and pacing adjustments, thereby significantly enhancing student engagement and achievement. Similarly, Ezzaim et al. (2024) demonstrates that data-driven AI techniques provide valuable insights for designing educational solutions that align with diverse learning styles. Expanding on these perspectives, Rane (2024) notes that Education 5.0 builds on Education 4.0 principles by emphasizing adaptive learning strategies where AI-fueled

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systems dynamically modify educational activities based on learner progress, ultimately fostering a more effective, self-directed, and efficient learning journey.

Conclusion

The integration of AI-enhanced Case-based learning (CBL) presents a promising model for improving problem-solving in cyberbullying education. AI models, particularly LLMs and transformer-based architectures, have demonstrated high accuracy in detecting and mitigating cyberbullying while also supporting emotional well-being through chatbot interventions. Meanwhile, CBL has been widely recognized for its effectiveness in fostering problem-solving skills across disciplines, with AI integration further enhancing learner engagement, scalability, and analytical skills.

By combining AI's ability to process and analyze complex cyberbullying scenarios with CBL's structured problem-solving six frameworks (case selection and data-driven contextualization, problem identification and role-based interaction, independent investigation and AI-assisted exploration, collaborative problem-solving and AI-driven feedback, solution presentation and interactive AI evaluation, reflection, adaptive assessment, and continuous learning), students can develop problem-solving skills in addressing cyberbullying cases. AI-enhanced CBL can offer real-world cyberbullying case simulations, adaptive feedback, and interactive learning experiences, equipping learners with the necessary competencies to recognize, prevent, and respond effectively to cyberbullying incidents. However, the effectiveness of this integration depends on the structured implementation, ethical considerations, and AI's ability to handle the nuanced social and psychological aspects of cyberbullying.

Recommendation

Future research should explore optimized learning models, AI model refinement, and ethical safeguards to ensure responsible and impactful AI-enhanced CBL applications in cyberbullying education.

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