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Online Tool for Misinformation Detection: Enhancing Media Literacy and Critical Thinking Skills

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Abstract

With the increasing spread of online misinformation, this research focuses on developing a multi-functional tool to enhance media literacy and critical thinking within online educational environments. The methodology involves a systematic literature review alongside the creation of a practical tool that serves as a 'Swiss army knife' for digital literacy. A key feature of this tool is a structured seven-step verification process for evaluating the credibility of sources, authorship, messages, and the legitimacy of media content. By integrating multiple techniques, this tool allows users to effectively identify and analyze potentially misleading information. The study deepens the understanding of disinformation dynamics in educational contexts and provides an innovative, practical solution to improve media literacy. The tool can be seamlessly integrated into online courses, thus enhancing the overall quality of digital education and fostering a more reliable learning environment.

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INTRODUCTION

Digital transformation in online education has significantly increased the spread of misinformation, posing significant challenges to information security and educational processes (Mhlanga, 2024; Pulenko, G., Zhukova, Y., Karagodskaya, J., Bazhutkina, 2023; Huber et al., 2019). Research by Vosoughi et al. (2018) revealed that the top 1% of fake news stories online reach between 1,000 and 100,000 individuals, while genuine news typically reaches only around 1,000 people. This discrepancy highlights the urgent need for effective misinformation detection mechanisms, especially in online learning environments where ensuring the accuracy and security of information is crucial for educational integrity and outcomes. As online education continues to grow, developing and integrating robust fact-checking tools, alongside promoting digital literacy, are critical steps in safeguarding educational environments from the pervasive threats of misinformation (Guess et al., 2019; Kathenya & Mbaka, 2022).

Misinformation encompasses various forms of information disorder, including the unintentional sharing of false information (misinformation), the deliberate creation of false information to cause harm (disinformation), and truthful information used maliciously (malinformation) (Claire & Hossein 2017). In educational contexts, the European Commission defines disinformation as "verifiably false or misleading information created, presented and disseminated for economic gain or to intentionally deceive the public, and that may cause public harm" (Commission., 2020). Misinformation can lead to misconceptions, hinder critical thinking skills, and erode trust in credible sources of information (Tay et al., 2021). In educational settings, misinformation is often spread through social media and unverified sources, influencing students' understanding of various topics. Allcott and Gentzkow argue that exposure to false information can have lasting effects on individuals' beliefs and decision-making processes, a concern amplified in educational settings where foundational knowledge is formed (Allcott & Gentzkow 2017).

Research on misinformation has largely focused on political and social contexts (Lazer et al. 2018;Pennycook & Rand 2019) and has primarily focused on general population samples rather than educational environments. This kind of research shows that while the general public is the main subject, online education environments have unique characteristics that can magnify the impact of misinformation, such as wider access and rapid spread among vulnerable learners. Furthermore, current misinformation detection tools are often complex and not tailored for educational purposes, limiting their practical application in online learning. More adaptive, user-friendly, and education-specific tools are needed to address these challenges. As the need to detect misinformation in online education grows, studies show that problem-based approaches and interactive modules can enhance critical thinking skills (Aulia & Yuliani, 2022;Bellam, 2023). Additionally, interactive media and platforms like Schoology have improved conceptual understanding effectively (Palee et al., 2024). Highlighting the need for accessible tools to identify misleading information.

Recent findings emphasize the critical role of integrating media literacy and critical thinking in detecting misinformation on social media. For instance, research has demonstrated that critical thinking dispositions and new media literacy are positively associated with the ability of university students to identify fake news on social platforms. Such evidence highlights the necessity of fostering these skills to effectively combat the spread of false information (Aïmeur et al., 2023; Yee & Huey Shyh, 2024). Moreover, comprehensive literature reviews have identified key challenges in the automatic detection of fake news on social networks and classified various types of fake news. While these studies provide a strong foundation for understanding the context of misinformation, existing solutions are often partial and do not fully integrate aspects of media literacy with practical applications (Allcott & Gentzkow, 2017; Orhan, 2023). Further research on media literacy has shown that education can enhance media resilience and civic engagement, particularly among younger generations. However, few studies explicitly combine critical thinking as a primary tool in identifying fake news, indicating a research gap that needs to be addressed. In this context, problem-based learning approaches have also been applied to enhance media literacy among journalism students, reinforcing the relevance of practical education in combating misinformation (Machete & Turpin, 2020; McDougall, 2019).

While existing research highlights the significance of media literacy and critical thinking in addressing misinformation, most studies remain focused on theoretical exploration or specific technical solutions like algorithms for fake news detection. Most tools and approaches either lack a comprehensive integration of critical thinking within media literacy frameworks or fail to bridge the gap between theoretical knowledge and practical, real-world application. This creates a gap in developing a holistic, multi-functional tool that not only teaches media literacy and critical thinking but also does so in a manner that is engaging and easily adopted in diverse educational contexts. Addressing existing gaps in the field, this research developed a user-friendly, multi-functional tool specifically designed to enhance media literacy and critical thinking in online educational settings. The objectives are to analyze and categorize how different types of misinformation appear in online educational contexts, develop a practical tool that integrates various techniques for identifying and analyzing misleading content, and evaluate the tool's effectiveness in improving students' ability to detect misinformation and enhance critical thinking. This unique approach emphasizes combining academic analysis with real-world application while keeping it accessible to teachers and students. The goal is to equip students with the skills to navigate the complex digital information landscape by providing a versatile "Swiss Army knife" of digital literacy resources.

METHOD

This research employed a multifaceted approach to develop and evaluate a disinformation detection tool for online learning. The methodology consisted of several steps. First, a systematic literature review was conducted (Machete & Turpin, 2020). The researcher reviewed peer-reviewed articles published between 2015 and 2023, focusing on misinformation, fake news, and media literacy in an educational context. Databases, including Web of Science and Google Scholar, were searched using the keywords "disinformation detection," "fake news in education," and "digital media literacy." This review informed the theoretical framework, particularly on (Aldwairi &

Alwahedi, 2018), the information disorder model, and Pennycook & Rand (2019) strategies for combating misinformation.

A categorization was adopted based on the (Commission 2020) definition of disinformation, which the researcher adapted and extended to an educational context. The resulting framework categorizes educational misinformation into factual errors, miscontextualized information, manipulated content, and fabricated materials.

Next, the methodology for developing a rule-based disinformation detection algorithm includes:

1. Assessment of the source's credibility according to signs selected from the studied database of verified educational resources.
2. Author verification by cross-referencing with academic databases and professional networks.
3. Content analysis using techniques to detect bias, inconsistency, and emotional manipulation.
4. Image and video verification using reverse image lookup and metadata analysis.

The tool was developed using HTML, CSS, and JavaScript. It implements a seven-step verification process inspired by the lateral reading strategy presented in Figure 1 (Wineburg & McGrew, 2019).

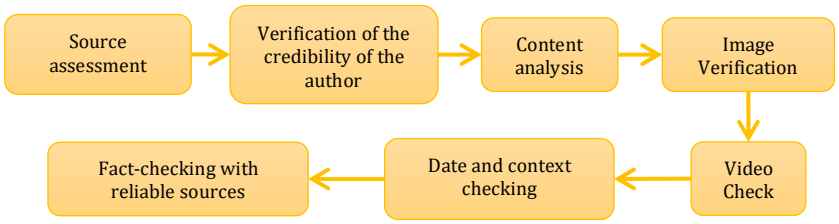

Figure 1. Seven-step Verification

Following its development, a mixed-methods pilot study was conducted on 200 students (aged 18-25) studying National Security. They were divided into two groups of 100 people, all receiving training in a media literacy training module based on best practices in media literacy training (Kahne & Bowyer, 2017). It consisted of five interactive lessons covering types of misinformation, critical thinking strategies, cooperative fact-checking, and non-inflected writing tasks. One group used the developed detection tool for the purpose, and the other group did not.

The module's effectiveness was assessed through pre- and post-assessments of media literacy skills and critical thinking abilities. All were given a pre-test and post-test to measure the ability to identify misinformation using a set of 20 real and fake online posts. This methodology provides a robust framework for developing and evaluating a disinformation detection tool tailored to an educational context. By integrating established research practices and addressing potential limitations, the researcher aimed to contribute a valuable resource for improving media literacy and critical thinking in online learning environments.

RESULTS AND DISCUSSION

Through this research, an online platform was developed and evaluated to strengthen media literacy and promote critical thinking skills in the context of online education. The literature review revealed a pressing need for such tools, as the ability to detect misinformation has become increasingly crucial in digital educational environments (Lazer et al., 2018; Vosoughi et al., 2018). In analyzing specialized literature, the researcher identified the imperative to define and classify various forms of false information in digital education. To establish a robust framework for misinformation detection, this research differentiates between key concepts such as fake news, disinformation, and propaganda (Claire & Hossein, 2017; Das & Ahmed, 2021; Jussila et al., 2021; Smith et al., 2021). The nuanced distinction between "fake" and "false" information is particularly noteworthy; fake news typically contains elements of truth, whereas false information is entirely fabricated (Putra, 2024).

In the context of online learning, the researcher defines fake news as "information that is completely incorrect or misappropriated, exaggerated or misrepresented to the extent that it is no longer true, presented as genuine educational content or deliberately disseminated misinformation with the purpose of misleading learners and potentially gaining political or economic benefit" (Yates,

2015). This definition aligns with the European Commission's broader conceptualization of disinformation (Commission., 2020), emphasizing its potential impact on the learning process. To address these challenges, this study emphasizes the importance of source evaluation in assessing the reliability and credibility of information in online learning materials. The researcher distinguished between direct (primary) and indirect (secondary) sources, noting that direct sources are essential for verifying information in educational content (Wineburg & McGrew, 2019). The prevalence of anonymous sources in digital content emerges as a challenge for misinformation detection in online learning, highlighting the need for cross-verification across multiple reliable sources (Flanagin et al., 2014).

What is the source?

An initial step in assessing a news story involves identifying the source type, whether primary, secondary, or anonymous. Online, this begins with a visual inspection of the website where the news is published. Users should check if the site appears professionally designed or cluttered with irrelevant ads (Im et al., 2021; Zha & Wu, 2014). Additionally, users should consider questions like Is the site using a free domain or mimicking a well-known news outlet? Do the "About Us" and "Contact Us" sections provide verifiable information, such as a legitimate name, address, phone number, and email, that can be cross-checked in the international domain registry? This part of the tool offers various features to help analyze the domain's history, uncover any previous misuse, and search for site code identifiers, like Google Analytics, which can assist in tracking the actual owner of the site.

Who is the author of the news?

Is the text signed, and who is the actual author? The tool offers apps that help investigate the author's identity and digital footprint, including specialized search engines for social media profiles, emails, and phone numbers. These resources enable users to build a digital profile of the authors, allowing them to determine if they are credible experts in the relevant field.

What is the message?

Does the article present multiple perspectives, or is it biased and only shows one side of the truth? To address this, the tool offers applications to evaluate the text's quality, check for plagiarism, and assess the uniqueness of the content. Additional features help determine credibility, such as identifying spelling errors, verifying proper source citations, and evaluating overall reliability.

Are the provided photos legitimate?

Confirming the authenticity of images plays a vital role in assessing the reliability of a news story. Any signs of image manipulation warrant a cautious and critical approach to the associated information. Images must be checked for unnatural proportions, color inconsistencies, or suspicious details. The tool provides applications for performing reverse image searches to trace the source of the images. Additionally, it includes features to detect technical edits intended to deceive, analyze EXIF data, and identify any inconsistencies or mismatched details in the image (Budiningsih et al., 2024;Gotmare et al., 2024).

Are the provided video clips legitimate?

In validating the video clips, it is essential to analyze the media context using applications that can extract images from the clip, perform reverse image searches, and verify the clip's metadata. Additionally, these tools help check the account information of the person who posted it on social media, ensuring that the source is credible and the content is authentic (Dimov, 2021; Savchenko & Makarov, 2022).

When and where?

When was the article, photo, or video published? Updated content may include outdated information or details that have since been refuted or discredited. For instance, if a video claims that an event took place in Aleppo, Syria, on a specific date and the footage shows it was raining, the researcher can use the provided tools to check if it was raining in that city on that date. To further

validate the event's location, services like Google Earth or Street View can be utilized to compare the actual appearance of the location with the street, place, or building shown in the video or photo.

Why was it published?

Finally, it is important to ask why the news story was published in the first place. What is its purpose to inform or to manipulate? To think critically about this, the following three fundamental questions need to be considered:

1. Should the source and the author be trusted?
2. Are there suspicious signs of tampering with the content of the text, images, and videos?
3. Are the answers to the "when and where" questions consistent with the time and place indicated by the author?

The answers to these questions help determine whether the information is reliable, partially, or completely unreliable. These questions form the basis of the tool's algorithm, designed to help users detect signs of misinformation and make informed decisions about the credibility of online content. To evaluate the effectiveness of the tool and training module, the researcher conducted a pilot study with 200 undergraduate students (aged 18-25) studying National Security and Defense. The participants were divided into two equal groups of 100. Both groups received a media literacy training module based on best practices established by (Kahne & Bowyer, 2017). The experimental group used the newly developed disinformation detection tool during training, while the control group did not.

Before starting the training, both groups took a pre-test of 20 online posts (10 true and 10 containing misinformation). For each participant, the number of correctly identified posts is recorded, after which the percentage success rate is calculated. The mean success rate and sample standard deviation were calculated using the Jamovi statistical processing program (Kazempour, N., Mirmohseni, M. & Aref, 2024;Sequeira & Borges, 2024). Finally, a t-test was performed to determine if there was a significant difference between the two groups. The initial test results were as follows:

1. The experimental group (Marked by row A in the table) had a mean response accuracy of 61,9% and a standard deviation (SD = 8.46), indicating that most scores were close to the mean;
2. A control group (row B) had a mean accuracy of 61,0% and a standard deviation (SD = 8.68), meaning 61 percent of responses were correct with a variation of 8.68 percent up or down;
3. An independent t-test revealed no significant difference between groups at baseline, p = 0.48 (Rouder et al., 2009).

Table 1. Jamovi Statistical Processing Results

One Sample T-Test

					95% Confidence Interval	
		df	p	Mean difference	Mean	SD
A	Student's t	99.0	< .001	61.9	61.9	8.46
B	Student's t	99.0	< .001	61.0	61.0	8.68
C	Student's t	99.0	< .001	86.1	86.1	6.54
D	Student's t	99.0	< .001	74.0	74.0	7.89

After completing the training module, they were retested with another 20 online posts containing 10 real and 10 fake posts. The results were also processed in Jamovi and are as follows:

1. The experimental group (row C) trained with this tool showed a mean response accuracy of 86,1% (SD = 6.54), an improvement of 24,2 percent;
2. The control group (row D) achieved a mean response accuracy of 74,0% (SD = 7.89), an improvement of 13 percentage points;
3. Paired t-test showed significant improvements for both groups ($p < 0.001$).

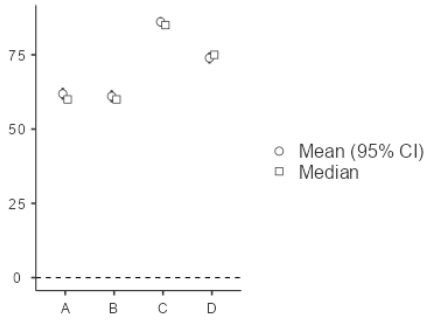

Figure 2. Descriptive Plots

Semi-structured interviews with experimental group participants revealed the following:

1. 85% of learners report increased confidence in identifying misinformation;
2. 78% find the tool convenient and intuitive;
3. 92% expressed intention to use the tool in their future academic and professional work.

After completing the new module, learners were better informed about the types of disinformation, and their critical thinking skills and ability to assess the credibility of information improved qualitatively. The experimental group using the developed disinformation detection tool demonstrated significantly greater improvements, suggesting that combining the media literacy training module and the detection tool enables students to evaluate misleading information more critically than the module alone.

The performance gap between the two groups (24,2 percentage points for the experimental group and 13 for the control group) indicates that the training module effectively enhances media literacy skills. These findings align with prior studies by (Aïmeur et al., 2023; Yee & Huey Shyh, 2024), emphasizing the role of critical thinking dispositions and media literacy in detecting misinformation. Unlike earlier works focusing on general populations or algorithmic approaches (Lazer et al., 2018; Vosoughi et al., 2018), this study bridges theoretical insights and practical applications within online education, offering a tailored solution for educational contexts. Additionally, 85% of participants reported increased confidence, and 92% expressed an intention to use the tool in the future, indicating its potential for long-term impact on students' information evaluation practices. This is especially important in online education, where critically assessing information sources is crucial for academic success and lifelong learning (Allcott & Gentzkow, 2017).

The tool's user-friendliness, reported by 78% of participants, is a key factor in its potential for widespread adoption. Given its ease of use, the researcher recommends integrating the tool into existing media literacy curricula, especially in fields where information accuracy is crucial, such as National Security and Defense studies. For effective implementation, comprehensive training for educators and students is essential to ensure the tool is used optimally. Additionally, policymakers should consider incorporating similar tools into broader digital literacy initiatives, aligning with established frameworks such as those proposed by the (Commission., 2020;Jie Lu, Matthew Schmidt, 2022). As noted (Chen et al. 2015), the success of educational technology integration heavily depends on user-friendliness. These findings contribute to the growing research on misinformation in educational contexts and offer practical strategies for enhancing media literacy in online learning environments. The combination of theoretical knowledge, practical application through the tool, and targeted training provides a promising approach to equipping students with the skills needed to navigate the complex information landscape of the digital age.

It is important to acknowledge some limitations of this study. While the sample size was sufficient for a pilot study, expanding it in future research would improve the generalizability of the findings. Ethical considerations, particularly regarding data privacy and the potential misuse of such tools, also require careful attention. Clear guidelines for the responsible implementation and use of misinformation detection tools in educational settings are essential. Additionally, long-term follow-up studies are recommended to assess the lasting impact of improved media literacy skills. Despite these limitations, this research offers valuable insights into the specific challenges of misinformation in online education and provides a practical solution to enhance media literacy. The implications extend beyond immediate educational outcomes, potentially influencing how future generations evaluate and engage with online information across various domains of life.

LIMITATION

Although this study successfully demonstrates the potential of the misinformation detection tool, its scope is limited to a pilot phase with a specific sample. Expanding the research to larger, more diverse populations and evaluating its sustained effectiveness in various disciplines would provide deeper insights.

CONCLUSION

This study developed and evaluated an innovative online tool for misinformation detection designed to enhance media literacy and critical thinking skills in online learning environments. Addressing a critical gap in digital education, this research offers both theoretical insights and practical solutions to the growing challenge of misinformation. By integrating established frameworks and typology of fake news, the findings contribute significantly to the broader discourse on misinformation. The researcher extends these concepts to online education by proposing a refined definition of fake news specific to educational settings and introducing a practical classification system for various forms of misinformation. While the results are promising, particularly in equipping students with critical thinking skills and effective tools for detecting misinformation, certain limitations must be acknowledged. The sample size, though adequate for a pilot study, may limit the generalizability of the findings, and focusing on a single academic field could restrict the tool's applicability to other disciplines. Future studies should consider expanding the sample size, refining the tool based on user feedback, and exploring its application in more diverse educational contexts. Despite these limitations, this research represents a significant step forward in tackling misinformation in online education and contributes to developing more reliable learning ecosystems. As the digital landscape continues to evolve, it is crucial to keep advancing strategies for fostering critical thinking and media literacy among learners, ensuring long-term resilience against misinformation.

AUTHOR CONTRIBUTION

PSD conceptualized the research, meticulously designed the analytical framework, conducted an in-depth evaluation of the developed misinformation detection tool, and prepared the final manuscript for publication. His contributions bridge theoretical insights and practical applications, providing innovative solutions to enhance media literacy and critical thinking in online educational environments.

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