

Education as a countermeasure against disinformation

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1 Introduction

At a time when digital information is flooding the world, the ability to identify and manage disinformation has become one of the most critical skills of our time. Disinformation - information deliberately created to mislead - spreads effectively through social media and other digital platforms (Juul & Ugander, 2021). It can be difficult to detect and even more difficult to prevent. Disinformation takes many forms and its effects can be harmful and far-reaching, ranging from undermining trust in public institutions to influencing elections and harming public health (European Commission, 2022a; Ecker et al., 2024). Disinformation is, therefore, a challenge to the democratic process. Misleading information can affect our ability to make informed decisions and participate in society as informed citizens. The availability of increasingly sophisticated generative AI has enhanced the ability to spread propaganda and disinformation (Goldstein et al., 2024). The education system now faces the challenge of equipping people with the knowledge, skills and constructive attitudes to deal with this complex reality. It is now evident that education can and should play a central role in this effort (e.g. European Commission, 2022a). This has led to increased efforts to develop interventions aimed at helping individuals become better at critically evaluating information and resisting disinformation.

Disinformation education, often focusing on media and information literacy (MIL), can play an important role in strengthening people's ability to identify false information and develop the cognitive skills needed to examine information critically. However, research shows that there are no quick fixes to this problem (Bateman & Jackson, 2024) and that instruction needs to be well-designed to achieve long-lasting effects. There is also a risk of side effects from MIL interventions, such as excessive scepticism or confidence boosts that are not accompanied by corresponding increases in skill levels (Haider & Sundin, 2019; Nygren et al., 2024). We all encounter misleading information and everyone sometimes has difficulty distinguishing true from false. Even professors and students at elite universities can have great difficulty distinguishing credible information from nicely packaged but misleading information (Wineburg & McGrew, 2019). Young people in particular have difficulty navigating digital information and are therefore more susceptible to misleading information and propaganda than is often assumed (see e.g. Breakstone et al., 2021; Kyrychenko et al., 2024; Nygren & Guath, 2022). Several studies from different parts of the world show that people have difficulty distinguishing opinion from fact and fake from real (e.g., Arechar et al., 2023).

One reason why it is easy to be deceived is that today's social media presents information attractively. Algorithms are biased towards content that attracts attention and thus favour novel and emotive information, which is also more likely to be shared (Brady et al., 2017;

Kozyreva et al., 2020). In addition, the rapid flow of news means that we rarely stop to consider whether something is true or not before sharing misleading information (Pennycook & Rand, 2021). The influence of emotion and intuition can then foster the formation of false beliefs (Martel et al., 2020). It can be particularly difficult to distinguish between more and less credible information if you are overly confident in your skills to identify misinformation (Köbis et al., 2021; Lyons et al., 2021). Thus, being confident in one's skills can be a matter of ignorance, not least among teenagers (Nygren & Guath, 2019).

New technologies make it possible to manipulate videos, so-called deepfakes, and fool even those with good knowledge of digital technology (Köbis et al., 2021). Technology is evolving rapidly, and the methods used to spread false information are becoming increasingly sophisticated. This means that no one is immune, and disinformation training must constantly evolve and adapt to new circumstances.

Moreover, many types of disinformation are not entirely false but contain grains of truth mixed with misleading or biased information. This makes it difficult for individuals to completely dismiss the information as false, which can create confusion and uncertainty. Ecker et al. (2022) describe this as a key problem, as people can find it more difficult to deal with information that is partially accurate yet misleading than information that is blatantly false. Dealing with this issue requires a nuanced teaching approach, where students learn to identify and analyze the subtle manipulations often used to distort truths. It is not just about identifying falsehoods but also about understanding how facts can be distorted and presented in a way that leads the recipient to draw improper conclusions.

Research shows that it can be difficult to stay informed. For example, disinformation about Covid-19 has been spreading all over the world, with younger people and people who get their news from social media more likely to believe these myths (Roozenbeek, Schneider, et al., 2020). Disinformation can reach young people through different channels; for example, malicious rumours about social services or extreme pro-violence anti-democratic disinformation can propagate not only through mainstream social media (e.g., YouTube, TikTok) but also through online games and podcasts (Butler & Ecker, 2023; Pamment et al., 2023; Ranstorp & Ahlerup, 2023; Sarnecki et al., 2023), and sharing on closed platforms (e.g., WhatsApp, WeChat) and offline sharing (e.g., family and peer networks) must also be considered (Butler & Ecker, 2023; Nurse et al., 2022).

With regards to online disinformation in particular, there is, unfortunately, a digital divide between groups with better knowledge and skills to deal with digital news and others with less knowledge and skills who are more gullible. Not least, there are differences between students in different educational streams and students with different socio-economic backgrounds. Students in vocational programs or from different linguistic backgrounds tend to have more difficulty navigating digital news feeds than students on academic tracks and can, therefore, be more easily misled (Nygren & Guath, 2022). Education that strengthens both subject-specific knowledge and the ability to navigate digital information can narrow this gap. By including media and information literacy instruction,

students can learn where and how to find credible information while developing skills to critically examine information they encounter (European Commission, 2022a).

Good subject knowledge can play a crucial role in how well individuals can navigate this complex information landscape (Guath & Nygren, 2022; Nygren & Guath, 2022). In particular, educational attainment and orientation, as well as a person's ability or inclination to engage in actively open-minded thinking (e.g., be prepared to consider evidence that goes against an existing belief) and their appreciation of democratic ideals, are strongly linked to the ability to distinguish between credible and misleading news (Arechar et al., 2023; Guath & Nygren, 2022; Roozenbeek, Schneider, et al., 2020; Roozenbeek et al., 2021). A key aspect of this is that education affects individuals' ability to scrutinize and assess the credibility of information. Studies show that people with higher education often have better skills to analyze and evaluate news. This can be linked to the fact that higher education often requires critical thinking and analytical skills, which help individuals understand both the content and context of news reporting. Subject knowledge becomes particularly important as it provides a deeper understanding of how information is constructed and presented in different fields (Osborne et al., 2024). People with good factual knowledge of a subject area are better at identifying what appears inaccurate or misleading. Researchers have long argued that facts combined with knowledge of prominent misleading narratives, myths as well as knowledge of misleading argumentation techniques provide a good defense against disinformation (Lewandowsky et al., 2020).

Good subject knowledge also makes us better at assessing source credibility. Therefore, researchers advocate education focusing on subject knowledge combined with knowledge of how and where to find good information (Nygren, 2019; Osborne & Allchin, 2024). Knowing where to find good information is at least as important as being able to identify dubious sources to be a well-informed citizen (Haider & Sundin, 2020). It is therefore important for teachers in different subject areas to highlight where high-quality information can be found and who can be trusted (or how trustworthy domain-specific sources can be identified) and to encourage critical ignoring of unreliable information or sources (Kozyreva et al., 2023).

But emotions and attitudes towards knowledge also matter. Those who value reliable and accurate information are better than others at distinguishing what is accurate from what is misleading (Arechar et al., 2023; Nygren & Guath, 2022). Education against disinformation requires a focus on knowledge, skills *and* attitudes – a combination sometimes called digital civic literacy (Nygren & Guath, 2022). A well-functioning democracy requires citizens who can distinguish between opinions and facts, and who can critically assess information in order to form evidence-informed views on important topics. Therefore, it is crucial that anti-disinformation education is integrated into broader civic education.

Critical source evaluation and critical thinking must be seen as key elements of democratic education. This means that people should not only learn to understand and

analyze information but also engage in an open and informed conversation about societal issues. The ability to understand how information is created and disseminated, to appropriately question power and authority, and to recognize manipulation is fundamental to participating in a democracy. Education is one of the most important defences we have against disinformation (European Commission, 2022a). By equipping people with tools for critical thinking, digital awareness and source evaluation, we can help them navigate the complex and often misleading information environment they encounter on a daily basis. It's not just about protecting individuals from being deceived - it's about strengthening democracy and creating a society where evidence-based knowledge, rather than manipulation, underpins collective decisions and actions.

Central to the concept of digital civic literacy is that it is not just about protecting the individual from being cheated or misled but strengthening democracy through "democratic self-defence" (Nygren, 2019). By developing citizens' ability to critically analyze information, especially in times where AI-created disinformation and other technologies can distort reality (Kidd & Birhane, 2023), we defend democratic values. When disinformation is deliberately spread by actors such as extreme ideological groups and foreign states, it becomes even more important to strengthen these critical skills and attitudes.

To address the challenge, education and training need to provide people with good subject knowledge and up-to-date competencies adapted to the digital realities we all face today, acknowledging that disinformation is a moving target.

2 Educational efforts that work

Research on interventions to strengthen people's ability to cope with disinformation has been growing strongly since 2016. Today, there is a lot of evidence on how short interventions can support individuals' ability to distinguish credible news from misleading information through short tips on thinking about where the information comes from, questions about whether they really believe the information is accurate, short videos and game-based learning (Ecker et al., 2022; Roozenbeek et al., 2023). When it comes to interventions against disinformation at the individual level, it is often argued that supporting people's digital self-defence through critical thinking, media literacy and, not least, social support from the environment and society in the form of legislation, fact-checking, and transparent labelling of content is helpful (Fazio et al., 2024; Kozyreva et al., 2024). Effective interventions, such as those mentioned above, have often been tested in online panels with participants who know they are in a research study, meaning that interventions have rarely been assessed under realistic conditions. It is, therefore, somewhat unclear to what extent these interventions also work in the community. What works when people are paid to take part in an experiment on source evaluation, for example, does not necessarily work as well in everyday life. While existing work conducted in the field has identified intervention benefits (e.g., Roozenbeek et al., 2022), there can be significant limitations in real-world effectiveness. Therefore, more field research is needed, and there are calls for more comprehensive training interventions that take into account cultural differences and are tailored to different target groups, for example, through close collaboration in the development of the training (Roozenbeek et al., 2024).

2.1 Good news that educates

From a broader perspective, we can see that the consumption of news can have a positive impact on people's knowledge of what is happening in the world—knowledge that can protect against disinformation on current affairs.

Studies of the relationship between news habits and the ability to determine the credibility of news have previously shown unclear relationships, where good news habits are not necessarily related to the ability to identify disinformation (Damstra et al., 2021). However, current research suggests that there may indeed be positive associations; for example, efforts to foster regular engagement with news content can be beneficial for knowledge formation, truth discernment, and trust in news, especially for consumers with low baseline interest in news (Altay et al., 2023, 2024), even in times when the news focuses on heated issues such as war and extremism (Altay et al., 2024). News that

highlights misleading narratives can also raise awareness of circulating misinformation and boost trust in legacy media by drawing attention to the importance of editorial standards (Altay et al., 2023; Thorson, 2024). At the same time, it can be concluded that good news habits alone are not sufficient, and researchers call for a combination of measures to help people deal with disinformation.

2.2 Media and information literacy training

Education has long been recognized as central to countering the spread and impact of disinformation, and a recent review of measures to counter disinformation highlighted media and information literacy (MIL) education as promising based on current research. Bateman and Jackson (2024) note that there is considerable research evidence that MIL can be effective in countering disinformation. However, they emphasize that to be effective, such training needs to be carried out accurately using research-based principles. This type of training often requires the presence of teachers and content adapted to the target audience. Good training includes a mix of teacher-led and student-active exercises (Martella et al., 2024). The teacher in such a practice shows, explains, challenges and creates conditions for practice and reflection (Nygren, 2019). Thus, MIL training faces significant challenges in terms of resourcing, scalability, time, and reach. It can take many years to implement comprehensive education programs on a broad scale, making it both costly and time-consuming to have far-reaching impact and, more specifically, to engage those most vulnerable to disinformation (Bateman & Jackson, 2024).

That being said, if implemented well, MIL training consistently shows promising results. Providing knowledge and awareness of journalistic practices, media manipulation and disinformation techniques, as well as promoting an understanding of the media industry, the internet and digital technologies is key (Bateman & Jackson, 2024; European Commission, 2022a). MIL has long been part of public education and humanities education in developed democracies, especially in subjects that emphasize critical reading and thinking, such as language, essay writing, civics and rhetoric. Public libraries have also historically promoted media literacy. But more is needed as the digital environments evolve. MIL education for adults can take place in libraries, senior centers, at leisure events or in professional contexts. There is currently research showing how MIL training can work for both very young people (e.g. Kohnen et al., 2020) and an older population (Moore & Hancock, 2022).

2.3 Learning to identify manipulation by manipulating others

One type of intervention that has had good effects has focused on teaching people to identify manipulative strategies by allowing them to experience and apply well-known manipulative strategies themselves in a game environment (Lewandowsky & van der Linden, 2021). In the educational context, games such as *Bad News* can play an important role in 'inoculating' people against disinformation (also see Cook et al., 2023; for a review

see Kiili et al., 2024; Roozenbeek & Van der Linden, 2019). By understanding manipulation strategies, people become better equipped to identify and resist misleading persuasive argumentation. This type of game has been shown to be effective across cultures (Roozenbeek, van der Linden, et al., 2020), including in messy real world classrooms (Axelsson et al., 2024). In the *Bad News* game, players take on the role of a disinformation creator, thereby gaining insights into the techniques and strategies used to manipulate audiences. This reverse perspective can be an effective way to increase understanding of the mechanisms of disinformation, but it is also important that the game is followed by discussion and reflection to reinforce learning. There are also calls to use narrative game elements to focus more on socio-emotional factors that can contribute to misinformation susceptibility (Devasia & Lee, 2024). Gamification can complement traditional teaching methods by creating an interactive but safe learning environment, simulating realistic scenarios with different learning challenges (Axelsson et al., 2021). It can also act as a motivational tool to make learning more fun and engaging for students, which is important for achieving long-term outcomes (Axelsson et al., 2024).

Long-term efficacy is a challenge for most interventions, including inoculating games and simulations (Maertens et al., 2021). Often, participants are enthusiastic after a short simulation or gaming experience and demonstrate immediate benefits, but without repeated practice, these effects tend to fade. While there is some evidence of sustained impact if interventions are followed by ‘booster shots’, that is, repetitions over time (Leder et al., 2024; Maertens et al., 2023), decay does present a significant efficacy challenge. Again, this suggests that systematic incorporation of educational interventions in curricula is important for long-term benefits. It is also important to accurately measure impacts, not only through self-assessments, where participants report on their experience but through more objective evaluation methods that can identify actual improvements in critical thinking and disinformation awareness (European Commission, 2022b). Merely relying on self-reported data is therefore insufficient, and it is important to study long-term effects to avoid an overly positive but inaccurate picture of the effects of gamified learning.

2.4 Acting as a fact checker

One of the most fundamental skills for navigating today's information environment is the ability to critically review sources. This means that a person needs to be able to assess where the information comes from, what the intention of the information is, and how credible it is. To do this, individuals must be able to identify where a piece of information originates from, that is, ascertain the person, group, or organization behind a message, and examine whether it is a reliable actor with competence, authority, and credibility in the subject area being addressed.

One skill that has been shown to be particularly useful in assessing the credibility of digital information is ‘lateral reading,’ where users check information received from one source against other independent sources (Breakstone et al., 2021). This approach differs

from the traditional method of reading vertically, where one stays on the same page (or more broadly with the same source) and tries to determine credibility based on how the information is presented. Lateral reading requires individuals to be accustomed to searching and comparing multiple sources simultaneously to check and verify information. Studies show that teaching lateral reading can improve people's ability to detect false or misleading information (Axelsson et al., 2021; Moore & Hancock, 2022; Wineburg et al., 2022), making this a key skill in disinformation education (Kozyreva et al., 2024).

At its core, lateral-reading education is about training people to think and act as fact-checkers. By integrating strategies used by professional fact-checkers with the use of digital tools such as reverse image search and video verification (also see next section), people can learn to uncover manipulated information and strengthen their own resilience to fake news and other types of misinformation (Axelsson et al., 2021; Nygren et al., 2021). Seeing how experts do it, actively applying the techniques, and getting feedback allows for a 'digital apprenticeship' that has proven highly valuable, especially if people can learn to uncover manipulated information and strengthen their own resilience to disinformation and different types of misinformation (e.g. Barzilai et al., 2023; McGrew, 2020; Wineburg et al., 2022). Such an approach is another example of how authentic and tailored learning environments, where students can practice real-life situations, can strengthen their ability to deal with disinformation (Axelsson & Nygren, 2024).

2.5 Ability to use digital verification tools

Dealing with disinformation is not only about analyzing text but also about being able to verify images and videos. This requires technical skills to use tools such as reverse image search and video verification tools (e.g. Google Lens and InvidWeVerify). These tools allow users to analyze the origin of an image or video and see if it has been manipulated or taken out of context.

Research shows that students who are trained to use these tools become better at distinguishing between genuine and manipulated images, which is particularly important in the age of deepfakes and AI-generated media content (Nygren et al., 2021). Being able to use these tools effectively is, therefore, an important skill for dealing with digital disinformation. This type of teaching can be understood as a way to foster students' 'technocognition' (Lewandowsky et al., 2017). Technocognition describes how people's cognitive processes interact with technology and digital tools. The ability to navigate information flows in a conscious way and use technological tools to support one's information processing is becoming increasingly important. Understanding how algorithms influence the news and content we see on social media is a key part of this skill (Kozyreva et al., 2020; Lewandowsky et al., 2024). All digital media users should learn how their behaviors can impact what content is shown to them, helping them to better understand how the flow of information can be manipulated. Teaching the concept of technocognition can help students understand and manage the vast amount of

information they encounter every day and use technology as a tool to navigate the information flood (Nygren et al., 2021).

2.6 Analytical thinking and thoughtfulness

Another important skill for detecting and evaluating misleading information is being able to apply a slow, analytical and reflective mindset. This contrasts with the more intuitive and automatic thinking we use when reacting quickly to information, which digital environments—and the often emotive (mis)information they present—often stimulate (Martel et al., 2020). Encouraging thoughtfulness and analytical thinking help people to step back, question the credibility of information and its source, and analyze the arguments. It can be valuable to create conditions for this through desirable difficulties with friction, providing participants with instructive challenges that force them to stop, think and rethink (Nygren, 2023).

Training aimed at developing this skill should focus on giving participants time to reflect, question and discuss the information they encounter. Research shows that analytical thinking is a strong predictor of an individual's ability to distinguish between true and false claims (Roozenbeek et al., 2021).

In terms of critical thinking, there are more general aspects of logical thinking and important links with good subject knowledge. Students with better subject knowledge can think critically more easily (Nygren et al., 2019), and experts in different disciplines appear to have different ways of critically processing information (Shanahan et al., 2011). Therefore, it is important to also focus on general and subject-specific knowledge in critical thinking education.

2.7 Integration of subject knowledge for specific areas

Integrating subject knowledge into teaching efforts relating to disinformation is crucial, especially in areas that are often affected by disinformation, such as scientific issues related to climate change or vaccines. Science education can serve as an important tool to provide students with knowledge about how scientific processes work and how to interpret data and research results. Students with a basic understanding of the methods of science are likely to be better equipped to recognize pseudoscience and false claims (Osborne & Pimentel, 2022). It is important for students to understand the scientific consensus in areas such as climate change, which can help them distinguish between accurate scientific information and misleading propaganda (Bayes et al., 2023; Osborne & Allchin, 2024).

Social studies and history are also important subjects to teach students about political propaganda, especially when it comes to recognizing how authoritarian regimes and extreme political groups use disinformation to influence public opinion. Students who

understand historical examples of propaganda and have better political knowledge are better prepared to recognize modern disinformation campaigns (Nygren, 2019; Vegetti & Mancosu, 2020). It needs to be pointed out, however, that some motivated political misperceptions might be more common among knowledgeable people (Flynn et al., 2017; Miller et al., 2016).

But here, too, it is necessary to measure the impact of teaching. It is not enough to see if students have understood certain scientific or historical facts; you also need to evaluate whether they can apply this knowledge to critically analyze new information.

2.8 Repetition and long-term effects

One of the primary functions of human memory is to build stable representations; updating one's memory and revising one's knowledge are, therefore, cognitively challenging tasks that require effort and persistence (Ecker et al., 2022). Retrieval practice, for example, through repeated (self-)testing, is crucial for new knowledge and skills to become consolidated in people's long-term memory and behavioural patterns (Brown et al., 2014). Skills that are not practised regularly may be lost (Maertens et al., 2021, 2023), making it important to create learning environments where, for example, students in schools are continuously given the opportunity to review and analyze information. One possible solution is to integrate source evaluation, media analysis and general information literacy lessons across different subjects, so that students practice these skills in different contexts (European Commission, 2022a), and combine such efforts with ongoing monitoring of impacts, to assess improvements and long-term effects of systematically repeated interventions.

2.9 Potential side effects

People tend to believe ideologically congruent information based on motivated reasoning and confirmation bias (Kunda, 1990; Strickland et al., 2011). Individuals may interpret counter-evidence as a threat to their identity or beliefs when dealing with politically charged or ideological issues, making it a challenge to correct misperceptions that bolster a person's worldview. While corrections can still provide some benefit in these situations (e.g. Ecker et al., 2022; Swire-Thompson et al., 2020), in individual cases, counter-attitudinal persuasion can be difficult, especially where misleading narratives are reinforced by political elites or partisan media sources (Nyhan, 2021).

There is also a risk that teaching efforts can raise general scepticism and cynical source criticism if criticality is exaggerated (Altay, 2022; Haider & Sundin, 2020). This issue has been raised, for example, with inoculation interventions (Modirrousta-Galian & Higham, 2023), but the problem may be limited (Leder et al., 2024).

Another potential side effect is overconfidence, which can arise if learners are taught how to identify disinformation but are not made sufficiently aware of their own limitations. For example, some students may develop an exaggerated belief in their ability to identify misleading visual information even when their actual ability has not improved (Nygren et al., 2024). To counteract these effects, it is important to teach disinformation in a way that not only focuses on increasing factual knowledge and skills but also emphasizes the importance of being humble and reflective about one's own ability to analyze information. Intellectual humility should be seen as a goal, as it is associated with misinformation discernment (Bowes & Fazio, 2024; Newman et al., 2022; Prike et al., 2024). Teachers and trainers should create an environment where learners can self-reflect on their misconceptions through discussion and critical analysis. A special focus on those who have difficulty understanding is needed to avoid unwanted side effects.

In all education, it is important to recognize and manage potential ancillary effects and ensure that participants have absorbed the correct information. As with other educational interventions, it is important to measure the impact of teaching holistically, to assess the presence of unwanted side effects and ideally pathways to mitigation (Tay et al., 2023). Objective measures and long-term follow-ups are needed to see how students' actual behaviours and attitudes change over time, combined with questions where students are asked to rate their confidence - to ensure that their self-image is consistent with their performance (Nygren et al., 2024).

2.10 Changing attitudes and developing digital civic literacy

Changing attitudes is often more challenging than filling knowledge gaps. While knowledge can be imparted through fact-based teaching, changing attitudes requires a deeper and longer-term process involving reflection, discussion and social interaction. Teaching should not only focus on filling knowledge gaps but also on basic attitudes and approaches to information. This is particularly important when it comes to countering disinformation (European Commission, 2022a).

A key component of this work is developing digital civic literacy - the ability not only to analyze and understand information but also to act as responsible and aware digital citizens. Children and adults need to learn to understand how their own information consumption and sharing affects both themselves and society. Developing this type of literacy means that people learn to be critical, reflective and responsible when interacting with information in the digital world (Kozyreva et al., 2020, 2022; Nygren & Guath, 2022).

Teaching may also need to engage participants on a personal level, giving them the opportunity to reflect on their own information habits and discuss them with others. Collaboration and group discussions can be effective tools to help participants see things from different perspectives and question their own preconceptions. This can be particularly useful for people in privileged positions in society (Galinsky et al., 2006).

Research shows that students who are given the opportunity to practice source evaluation and discuss and reflect on their opinions in groups can change their attitudes and become more critical of disinformation (Axelsson et al., 2024). In education, it can be helpful to see and practice different perspectives on an issue to become more reflective about difficult questions (Lo & Adams, 2018). There is potential for polarization, stereotypes, and misconceptions to be reduced by bringing people together and exchanging perspectives through systematic exercises (Bruneau & Saxe, 2012; Paluck et al., 2021). Seeing how political opponents can be sympathetic and have great similarities can also be helpful, and recalibrating potentially distorted, polarized perceptions of the world can support democratic values (Voelkel et al., 2023). Again, to ensure that training actually leads to changes in attitudes and increased digital civic literacy, it is important to accurately measure its impact.

2.11 Summary of challenges and opportunities of education against disinformation

Opportunities:

- By promoting good news habits and critical thinking, education can help build resilience to disinformation.
- Training that demonstrates, explains, challenges and creates opportunities for practice and reflection is recommended.
- Retrieval practice, repeated training, and integrating subject knowledge with source evaluation can yield long-term results.
- Gamification and simulations can give people a practical understanding of how disinformation is spread and how it can be managed.
- Collaboration and social interaction in structured ways can help people shift their perspectives and reflect on their own views.

Challenges:

- There are no quick fixes to the complex challenge of disinformation education; systematic, engaging, long-term efforts are needed.
- The effects of training can be short-lived if repetition and long-term interventions are not used.
- Psychological factors, such as the cognitive difficulty of belief updating and motivated reasoning, can make it difficult to correct misperceptions.
- Teaching can potentially have side effects, such as excessive scepticism or overconfidence.

- Teaching technical skills to identify disinformation is difficult, especially when technology is evolving rapidly.

Teaching against disinformation thus requires a careful balance between efforts to provide students with factual knowledge and develop their ability to think critically and analyze information in today's (and tomorrow's) digital world.

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