

PEGAP report from classroom intervention

Bad News Game in a Peer Education Intervention: Impact on attitudes but not on skills

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Introduction

Making people aware of misinformation and manipulative online strategies, so-called prebunking, has become an important part of inoculating people against misleading information. Based upon inoculation theories from social psychology (McGuire, 1964) it is today highlighted that a small dose of misinformation may provide an antidote against manipulation in a world of information disorder (Kozyreva, Lewandowsky, & Hertwig, 2020; Lewandowsky & van der Linden, 2021). For instance, showing people short videos of manipulative online strategies may help people identify and assess Islamophobic and radical-Islamist disinformation and make them more reluctant to share this (Lewandowsky & Yesilada, 2021). Playing online games with the purpose of misleading others with misinformation has proven fruitful in a number of cases. Games designed to inoculate people against political misinformation (Roozenbeek & van der Linden, 2020), extremist persuasion techniques (Saleh, Roozenbeek, Makki, McClanahan, & Van Der Linden, 2021) and misinformation about Covid-19 (Maertens, Roozenbeek, Basol, & van der Linden, 2020; van der Linden, Roozenbeek, & Compton, 2020). Using games to prebunk and inoculate against ‘fake news’ started in classrooms with a cardboard game (Roozenbeek & van der Linden, 2018) and this game was then redesigned to an online version with significant impact on

peoples abilities to assess misleading information (Roozenbeek & van der Linden, 2019). The Bad News Game has now been tested across cultures (Roozenbeek, van der Linden, & Nygren, 2020) and found useful to boost constructive attitudes in lab experiments (Basol, Roozenbeek, & van der Linden, 2020).

The promising results of online games as a vaccine makes it interesting to test this game in a classroom setting with young people living in a world where misleading information may be part of their news feeds. In this study, we go back to the starting point of the Bad News Game (classroom settings) and investigate if the game as a part of a media literacy training can help teenagers become better at assessing the credibility of fake and real news. In addition, we also explore if this intervention may support students' interest in following credible news sources and to what extent it may have an impact on their attitudes of trust and opinion regarding press freedom.

1.1. Inoculation theory and games to pre-bunk against misinformation

Researchers are today trying to develop a “vaccine” against fake news with a basis in inoculation theory developed in the 1960’s by William McGuire (Lewandowsky & van der Linden, 2021; McGuire, 1964). McGuire (1970, p. 37) stated that “We can develop belief resistance in people as we develop disease resistance in a biologically overprotected man or animal: by exposing the person to a weak dose of the attacking material, strong enough to stimulate his defences, but not strong enough to overwhelm them.” Inoculation theory has been used in many different research settings with an overall effect size, using Cohen’s *d*, of .43 (Banas & Rains, 2010). This effect size can be described as small or medium effect but still important in practice (Banas & Rains, 2010; Lewandowsky & van der Linden, 2021). Cohen (1988) described 0.4 as a small effect but more recently a common interpretation, not least in education, is that this effect size is a medium effect size (Hattie & Yates, 2013;

Sawilowsky, 2009). Effect sizes in studies of inoculation against misinformation range between small and large in designs inoculating against, for instance, Islamophobic and radical-Islamist propaganda (Lewandowsky & Yesilada, 2021) and climate change denial (Van der Linden, Leiserowitz, Rosenthal, & Maibach, 2017). When online games have been used to inculcate resistance towards misinformation, effect sizes range between $d=0.1$ and $d=0.7$ (Basol et al., 2020; Roozenbeek & van der Linden, 2019, 2020; Roozenbeek et al., 2020; Saleh et al., 2021). The game used in the present study was tested in a national context with a small to medium effect size in Sweden, $d=0.24$ (Roozenbeek et al., 2020). The effects of inoculation from the interventions have been described as important, even if they are small, in light of the challenge from misinformation where small effects may swing a political election (Lewandowsky & van der Linden, 2021). It has also been noted how playing the Bad News Game may have long-term effects (Maertens et al., 2020). One concern raised against teaching people how easy it is to manipulative information online is that this may rub off also on credible news foster distrust against freedom of speech and press freedom. In previous research, distrust has been handled by having control items with credible information (e.g. Roozenbeek & van der Linden, 2019), but trust in media and attitudes towards democratic values has not been tested in previous interventions.

Young people growing up in an era of online misinformation have been found to struggle to separate fake news from real news (Axelsson, Guath, & Nygren, 2021; Breakstone et al., 2019; Ku et al., 2019; McGrew, Breakstone, Ortega, Smith, & Wineburg, 2018; Nygren & Guath, 2021). It has also been noted that there may be a digital civic literacy divide between students with different backgrounds, knowledge, skills and attitudes (Nygren & Guath, 2021). Teenagers in urban schools may find it especially hard to navigate misinformation (McGrew & Byrne, 2020). The idea that young people are digital natives -

knowing how to navigate digital media much better than other generations - does not have any support in the research. Instead, there is a call for educational efforts to promote the digital civic literacy of teenagers with diverse backgrounds (McGrew, 2020; McGrew & Byrne, 2020; Nygren & Guath, 2021). Previous studies of online games to prebunk misinformation have not been directed towards teenagers in urban schools, even if they are believed to be in need of this type of education. Previous studies are, instead, based on self-selected (opt-in) participants interested in playing a “fake news game” (Roozenbeek & van der Linden, 2019; Roozenbeek et al., 2020) or paid participants recruited via platforms like Amazon Mechanical Turk and Prolific (Basol et al., 2020; Lewandowsky & Yesilada, 2021; Saleh et al., 2021; Van der Linden et al., 2017). This means that participants playing the online game may be more interested than most people of games and fake news and less likely to be teenagers in urban settings. Therefore, participants signing up for being part of research may not be the very people who are most susceptible to misinformation.

1.2. Peer education

Peer education, young people educating their peers, may be tracked back into history when Aristotle was teaching in Greece and 19th century teaching in Lancaster schooling, where students were supposed to monitor each other (Green, 2001). Advocates of peer education underline how it is empowering for young people and a cost effective way to reach especially young people who may be hard to reach in conventional schooling (Green, 2001). Peer-education is quite common in health education where it has been a productive approach regarding smoking and its dangers and peer-pressure may support teenagers’ attitudes towards drug use and smoking (Ayaz & Açıl, 2015; Hasel, Besharat, Ejeyeie, Hejazi, & Hakimzadeh, 2016). In contemporary research, peer education has not been combined with media literacy education, but advocates of peer-education find that this should be a constructive approach to

reach especially young people. For peer educators, it is positive to have credibility within the field of debate (e.g. first-hand experience from problems with gang related problems), to be able to communicate information in a clear and non-moralistic manner, to be identified by their peers as credible in relation to age and sociocultural aspects, and have shared experiences (McKeganey, 2000). Still, the impact of peer-education is not always substantial (McKeganey, 2000; Rees, Quinn, Davies, & Fotheringham, 2016). Talking to peers about important topics may be productive, but this also holds a number of challenges (Green, 2001). The challenges include the importance of training peer educators to know the content they are supposed to teach. It is also important to note that teaching and learning hold power relations which may be hard to handle, not least in a school context with a teacher present. Another challenge is the diversity of peers. Some groups of peers are far easier to reach in education and peer educators come with different backgrounds, skills and attitudes - which may be perceived by students as credible or not credible.

1.3. Design research

Implementing innovative technology in education is often linked to design research in education, also known as design experiments, design-based research and design study (Anderson & Shattuck, 2012). The usefulness of design research for this comes from its methods where researchers and instructors collaborate to iteratively identify challenges and test new materials and methods in complex classroom settings with a purpose to promote students learning (Andersson, 2011; Edelson, 2002). Design research advocate Ann Brown (1992) stresses the importance of collecting a large amount of data from messy classrooms in order to measure learning where it usually occurs, not in clinically untainted labs. She underscores how measuring effects through pre- and post-tests designed to fit the research focus of the study in this design experiment, inspired by pragmatic and post-positivistic

perspectives (Brown, 1992). This research is based on the assumption that the design of materials and methods is important for learning and focuses on developing new tools and theories for teaching in the complex reality of teaching and learning (Collective, 2003). The materials and methods developed through repeated studies in the classrooms should preferably survive the challenges of classroom practices and remain to be used in teaching long after the research project is completed (Kelly, 2004; Shavelson, Phillips, Towne, & Feuer, 2003). Design research advocates argue that educational science needs to develop ideas and products that work in thoughtful ways (Collins, Joseph, & Bielaczyc, 2004) and in this paper we present some steps in this direction.

1.4 The present study

In the current study, we conducted a pilot and an intervention to test the possibility of using Bad News Game to inoculate against misinformation in urban classrooms. This was part of an EU-funded peer-education program designed to strengthen resilience against disinformation and strengthen democratic citizenship amongst young people (PEGAP <https://www.diversion.nl/cases/pegap/>).

Based upon previous research on using the Bad News Game to inoculate against misinformation we investigated the following hypotheses:

H1: Credibility ratings of deceptive tweets will be lower after the intervention than before the intervention.

H2: Credibility ratings of true tweets will not be affected by the intervention.

In addition, we investigated the following research questions:

- i. Is the willingness to engage in credible news (credibility importance) affected by the intervention?
- ii. Is the confidence in media, politicians and researchers affected by the intervention? If so, is it negatively affected?
- iii. Are the attitudes to freedom to express extreme opinions, media freedom, freedom of speech and freedom of press affected by the intervention?
- iv. Is the self-rated comprehension of (a) how traditional media choose their news for publication and (b) how social media choose their content affected by the intervention?

Materials and procedure

In line with ideas underpinning design research, researchers and peer-education instructors collaborated to set-up a three-hour pilot including the use of Bad News Game in urban classrooms. This educational intervention included educational efforts, designed primarily by peer-educators with experience from this type of education, for instance related to issues linked to racism and prejudice. It included a first hour of personal stories and discussions about filter bubbles to introduce the subject of media literacy and introduce the peer-educator as a credible person with similar online issues as the teenagers in the classroom. Lesson two was focused on the Bad News Game where students played and discussed the manipulative strategies in the game. The final hour included an editorial classroom exercise previously used to promote democratic citizenship and highlight especially the importance of freedom of speech and press freedom.

Before and after the intervention, students were asked to fill out a questionnaire designed to evaluate the two main goals of the project (1) strengthening resilience against disinformation and (2) strengthening democratic citizenship amongst young people (see

Appendix A). The survey questions were a mix of self-rated questions and test items. We used self-rated questions linked to previous research about students' digital civic literacy (Nygren & Guath, 2019) and trust (Naef & Schupp, 2009) and we used tweets as test items in line with previous research of inoculation theory and gaming (Roozenbeek & van der Linden, 2019; Roozenbeek et al., 2020). The survey design was conducted as a collaboration between researchers and peer-educators, where peer-educators asked for instance questions closely linked to their educational intervention and decided what tweets designed by researchers to include.

Piloting

The peer-education design was tested in urban schools with 602 teenagers and 209 of them responded to pre- and post-surveys. In the pilot we did not collect individual codes and cannot link pre- and post-tests to individuals. Bearing in mind that we lacked many responses in the post-survey we conducted a simple analysis of means to get a sense about the attitudes in the group and how the students perceived the intervention. We found that the students perceived the freedom of speech and press-freedom to be quite important and to a lesser extent trusted the media. The students did not trust politicians as much as they trusted researchers.

Students in the pilot rated the intervention on a five-point scale as fun (3.3), interesting (3.1) and adequate in difficulty (3.2). Looking at the ratings of misleading tweets and reliable news, we could not find any impact on the students' abilities to identify manipulative strategies. This was a surprise and researchers and peer-educators discussed how this may be related to the design of the intervention, lack of data and/or problems with the test-items.

Design experiment

Considering the results from the pilot, changes were made in the introduction with a more limited focus on filter bubbles, since this is a disputed concept and the discussion may be distracting to students. We also decided to use more tweets from previous research since we considered that the lack of impact had to do with new and more complicated test items (see Table 1 and Appendix A).

Table 1. Tweets presented in randomized order in before and after classroom interventions and follow up.

Item name	Tweet
Emotion	Parents Weekly: NEWS ALERT Baby formula linked to horrific outbreak of new, terrifying disease among helpless infants. Parents despair
Impersonation	HBÖ: Next year there will be a new final season of #GameOfThrones season nine!
Discredit	International Post Online: The mainstream media has been caught on so many lies, that they cannot be viewed as a legitimate news source #FakeNews
Conspiracy	Daily Web News: The bitcoin currency exchange rate is being manipulated by a small group of rich bankers #ResearchNow
Trolling	Quad Media: Another shark loan for developing countries @WorldBank #WorldOfExtortion #HumanBanking
Polarisation	Rapid Updates: The myth of equal IQ between leftwing and right-wing people exposed #TruthMatters
Control Russia	SvD: Russian influence on the American election may be more significant than four years ago
Control Huawei	SVT: Huawei will be stopped from participating in the Swedish 5G-expansion #svtnyheter

Note: Test-items previously used in Roozenbeek et al 2020. Control items have been updated with reliable current news.

We also noted that the impact on democratic values did not seem to be negative, rather the opposite, which made us stay with the original design with the editorial classroom exercise. We also decided to limit the number of questions in the survey to make it easier for more students to fill in the post-intervention survey (see Appendix A).

The classroom intervention was originally planned to be conducted in classrooms during the first half of 2020 with students in an urban school setting. Our original plan was to have at least 90 students as participants, but the impact on teaching from Covid-19 made it

hard to find classrooms with students present and teachers were reluctant to provide time for peer-educators to come into classrooms since they were struggling with an increased workload due to the pandemic with a tedious mixture of classroom and online teaching during lock-downs. In collaboration with peer-educators we also decided to not have researchers present in the classroom during the intervention. This decision was grounded in previous research and experiences from problematic power relations in peer-education classrooms – where peer-educators may have a hard time to get authority and direct the teaching and learning when teachers and other adults are present (Green, 2001) and considerations of restrictions due to Covid-19. After a considerable delay, two interventions with a total of 56 students was possible in November 2020. We had planned four interventions, but the following two had to be cancelled due to a new Covid-19 lock down of schools. 30 out of 56 participants provided complete or almost complete responses in the pre- and post-tests. Analysing the impact from the intervention, we found again that the impact was very limited, which made us ask if the group of students are especially hard to teach or if the design with peer-education may be distracting. This made us conduct an online intervention at the same school in January and February 2021 to see if the impact of the game could be better without peer-education. In this online follow-up intervention, students without any preparation were asked to individually play the game and rate tweets before and after playing the game. A total of 23 students participated in this intervention, but only 10 of them provided complete responses in the pre- and post-tests. Thus, our data hold important limitations with a response rate of 34 percent in the pilot, 54 percent in the classroom study and 43 percent in the online follow up. The low response rates may indicate that it is a challenge for peer-educators to find time for surveys before and after interventions (especially in the pilot), a lack of interest among the teenagers to respond to the primarily the same questions two times and technical problems in the data collection. Limitations makes it hard to draw general conclusions

regarding the impact on how urban teenagers can be educated to better navigate misinformation. However, it is possible to investigate the impact among the urban teenagers choosing to participate and respond to pre- and post-tests.

Method

Participants

Participants in this study were identified as teenagers in an urban school with a need for more knowledge about misinformation. The experimental peer educational intervention study included 52 participants of which 33 (20 girls, 12 boys, 1 non-binary identity) provided the same code for both pre- and post-test. 30 of the students provided near complete responses to pre- and post-test. We included all responses to questions that were provided by the students. As this target group - who may not actively opt in and do an online survey - has not been investigated previously, we deem any results we can present useful for future studies. In the follow up with students using the game online under Covid-19 restrictions, 10 out of 23 participants provided complete responses on test-items.

Analysis of results

The classroom intervention and follow up was a within-subjects design, with the ratings of test-items and self-rated items in pre- and post-test as repeated measures, and rating on each separate item as dependent variable.

Because data were not normally distributed, we used paired samples Wilcoxon test (a non-parametric alternative to paired t-tests) to compare pre- and post-test ratings (a) of the tweets, (b) the attitude to freedom of speech related matters, (c) credibility importance, and (d) the comprehension of the publication process in traditional and social media (Jamovi

project, 2021; R-Core Team, 2020). For the confidence estimates of media, politicians and researchers, which consisted of categorical estimates, we used chi-square tests to compare differences between pre- and post-test.

Results

Skills to identify manipulative strategies: Rating of Tweets pre- and post-test

Participants rated the tweets quite low on a scale from 1 to 7 (see Table 2) both in pre- and post-test, except for the credible control tweets with reliable information, which were rated slightly higher, and the directions of ratings did not always go in line with the hypotheses. In the peer education condition there was a statistically significant difference between pre- and post-test for the tweet “discrediting” main stream media ($W=227.5, p=.039, d=.4$) see Appendix A. However, we also find a significant difference in the pre- and post-test ratings of the “conspiracy” tweet, in the opposite direction to our hypothesis when we conducted an ad hoc two-tailed analysis (higher in post-test than in pre-test, $W=27.5, p=.004, d=.7$).

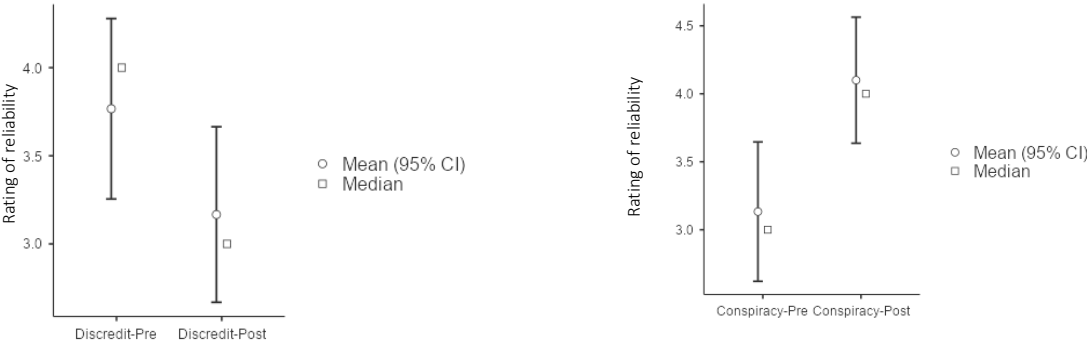


Figure 1. Significant impact from peer-education intervention in classrooms on students’ ratings of tweets in hypothesized direction (discredit) and opposite direction (conspiracy). Rating of reliability on a scale from

It is noteworthy that three out of six misleading tweets got a higher mean and median rating of reliability after the intervention (see Table 2).

Table 2. Mean/Median and Standard Deviation (SD) for Each Tweet, Categorised in Argumentation Technique, in Pre- and Post-Test.

Peer Education in Classroom (N=30)

Time	Trolling	Emotion	Conspiracy	Discredit	Impersonation	Polarization	Control 1	Control 2
Pre-test	3.3/3.0 (SD=1.2)	2.4/2.0 (SD=1.5)	3.1/3.0 (SD=1.4)	3.7/4.0 (SD=1.4)	4.6/5.0 (SD=2.2)	2.4/2.0 (SD=1.4)	5.2/5.0 (SD=1.1)	5.1/5.5 (SD=1.6)
Post-test	3.2/3.0 (SD=1.3)	2.4/2.0 (SD=1.1)	4.1/4.0 * (SD=1.3)	3.2/3.0 * (SD=1.4)	5.1/6.0 (SD=2.0)	3.2/3.0 (SD=1.3)	5.0/5.0 (SD=1.7)	5.4/6.0 (SD=1.7)

* ($p \leq .05$)

Follow Up, Game Only, (N=10)

Time	Trolling	Emotion	Conspiracy	Discredit	Impersonation	Polarization	Control 1	Control 2
Pre-test	3.6/3.0 (SD=2.2)	2.7/2.0 (SD=2.1)	2.7/2.0 (SD=2.1)	2.9/2.5 (SD=2.2)	2.3/1.0 (SD=2.2)	2.3/1.0 (SD=2.5)	4.9/4.5 (SD=2.1)	3.5/3.5 (SD=2.2)
Post-test	2.4/2.0 * (SD=1.5)	1.3/1.0 (SD=0.6)	1.8/1.0 (SD=1.9)	2.9/2.5 (SD=2.3)	2.3/1.0 (SD=2.0)	2.3/1.0 (SD=2.0)	3.5/3.5 (SD=2.2)	4.3/4.5 (SD=2.5)

* ($p \leq .05$)

Noting the lack of impact from the peer education design intervention, we also asked other students in the same school to play the online game. In this condition, playing the Bad News Game without peer-education, we find that the ratings of misleading tweets all go in the hypothesized direction, or show no difference of mean or median in pre- and post-tests. In this follow-up experiment, we found a statistically significant lower rating of trolling tweets ($W=31.0, p=.037, d=.6$), see Appendix B. And lower ratings on manipulative tweets focusing on emotions and conspiracy, but not statistically significant when analyzed in a paired samples Wilcoxon test.

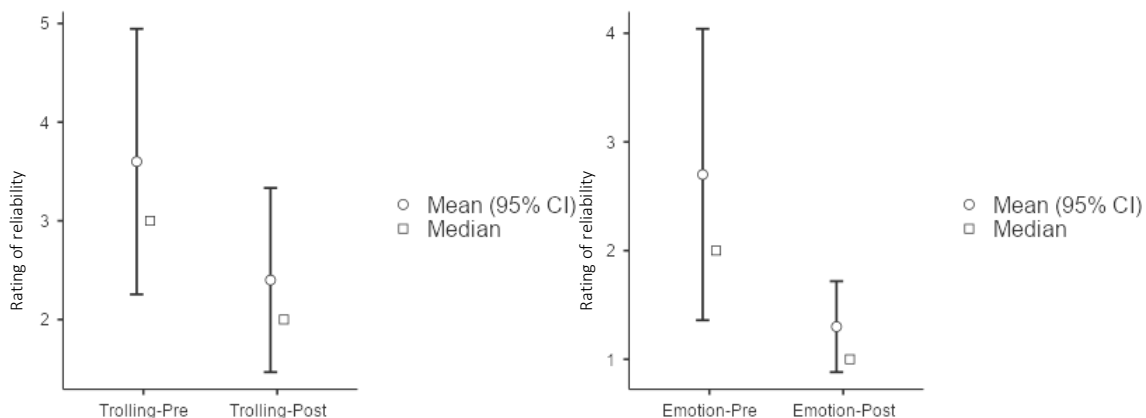


Figure 2. Significant impact from playing the game online on students' ratings of tweets in hypothesized direction, trolling and emotion.

Noting the limited number of participants, we also conducted a Bayesian factor analysis on the students' ratings of reliability in both conditions (Morey & Rouder, 2018; Rouder, Speckman, Sun, Morey, & Iverson, 2009, see Appendix B). This analysis confirmed the impact in the hypothesized direction of the ratings of the discrediting tweet in the peer educational setting and the trolling tweet in the game only setting. It also confirms the opposite direction of reliability rating polarization tweets in peer education. In addition, this analysis also shows how in the game only control condition made students rated the tweet manipulating emotions lower after the intervention.

Attitudes towards media and freedom of speech

Credibility of news and confidence in media

The ratings of credibility importance differed between the pre- and post-test in the classroom intervention. We did not include this question in the online follow up since we wanted to focus on the rating of tweets and limit the number of questions to the students. The mean and median rating of access to credible news as important on a scale from 1 to 5 was in the pre-test $M=3.96$ and $Md=4$ and in the post-test $M=4.39$ and $Md=5$. This was a statistically significant increase in the rating ($W = 24.0, p = .035, d=.46$).

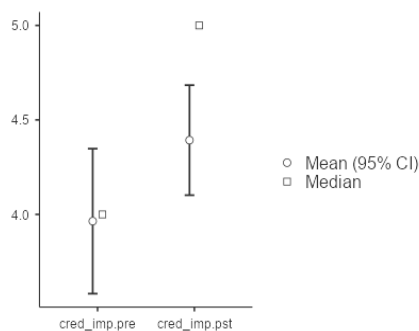


Figure 1. Rating of importance to have access to reliable news, pre- and post-intervention.

For confidence in media, politicians, and researchers there were no significant changes.

Freedom to express one's opinion

The ratings of the freedom of speech-related questions (see Table 4 and Appendix B) did not differ significantly on pre-and post-test. The median ratings are in most cases on the maximum value of the scale (1-5 point scale), except for freedom of media. In addition, there is hardly any variance in participant ratings, again the only construct with any variance is freedom of media.

Table 4.

Mean/Median and Standard Deviation (SD) for Freedom of Expressing Opinions – Even Extreme, Freedom of Media, Freedom of Speech and Freedom of Press for Pre-and Post-Test. All Constructs are Rated on a 1-5 point Likert Scale.

<i>Time</i>	<i>Freedom of opinion</i>	<i>Freedom of media</i>	<i>Freedom of speech</i>	<i>Freedom of press</i>
Pre-test	4.29/5.0 (<i>SD</i> = 1.2)	3.8/4.0 (<i>SD</i> = 1.1)	4.8/5.0 (<i>SD</i> = 0.4)	4.7/5.0 (<i>SD</i> = 0.5)
Post-test	4.1/5.0 (<i>SD</i> = 1.2)	4.1/4.0 (<i>SD</i> = 1.0)	4.8/5.0 (<i>SD</i> = 0.5)	4.7/5.0 (<i>SD</i> = 0.6)

After the peer education intervention, a majority of the students (15 of 27) claimed that they have become more suspicious towards media in general when responding to the question “Did the education make you distrust news media more?” 12 of 27 claimed not to have been affected in this way. Open ended responses justifying their claims included arguments like (a) Yes: I now understand that what is published are things that attract attention and they are not always true, (b) Yes: Because we understood through the game how to get followers and so on, (c) Yes: I have realized how much that can be fake since companies can easily make fake news sites and make money (d) No: Because the teaching refers to trusting the news media, and (e) No: I now have a better insight into how news is

spread and written. These responses highlight how students may take away different lessons from the intervention.

Self-rated comprehension of publication decision

The ratings of the comprehension of how traditional media select their news were quite high both for pre- and post-test ($Md = 4.0$, $MAD = 0$) and so were the ratings of comprehension of how social media select their content ($Md = 4.0$, $MAD = 0$).

Enjoy teaching

When asked to self-rate the level of teaching, learning from participation and to what extent the peer-education was fun, we find that the group on a scale from 1 to 7 rated this above four in all dimensions (see Appendix B).

Summary of results

To sum up, our results indicate that the use of Bad News Game in a peer-education setting may not have the same positive impact on students as playing it individually online. We also find that the peer-education intervention may support students' attitudes regarding the importance of following credible news. A majority of the students stated that they may have become a bit more critical towards media, but they still found it important to have freedom of opinion, media, speech and press.

Discussion

The importance of navigating online information is today highlighted as very important and complex in a world of information disorder (Wardle & Derakhshan, 2017) and infodemics (World Health Organization, 2020). The call for educational interventions has been almost

deafening and many programs have been launched to support people's media and information literacy, but only a few interventions have been designed and evaluated scientifically.

A weak dose of vaccine against misinformation

Our findings in this study underscores the importance and complexity of supporting teenagers' digital civic literacy. A game found to be useful to inoculate people against online manipulation may be complicated to implement in classrooms. Noting the limitations of this study conducted under conditions much affected by the Covid-19 pandemic, we still find some noteworthy results to discuss and better understand challenges and possibilities when educating young people. Previous research of peer education is very limited, but the potential of promoting good attitudes has been highlighted as a potential. Peers may affect their peers to not smoke or do drugs. In this intervention peers are supposed to make their peers better at navigating online information and support democratic values. Our findings indicate that the peer-education may do the latter but make the first more complicated. Our pilot and classroom study indicate that when a game proven useful in online settings (Roozenbeek & van der Linden, 2019; Roozenbeek et al., 2020) is used in classrooms as part of a peer-education program, results may be unpredictable. This may of course be due to the fact that previous studies have been conducted with older participants getting paid or choosing to engage online – not teenagers in urban settings. However, our follow-up experiment with students from the same school indicate that this may not be the cause of lack of impact. Instead, we find it possible that the intervention with peer-educators telling personal stories, discussing filter bubbles on Instagram and the complexity of editorial choices may distract students' attention from the learnings possible from playing the Bad News Game. The new setting with peer-educator (environment) and the rich content of the three-hour classroom intervention which pointed in different directions (extraneous load) may have caused a “cognitive overload” among students not understanding what to identify, trust and not to trust (Chandler & Sweller,

1991; Van Merriënboer & Sweller, 2005). It may also be that the teaching made the students a bit tired before playing the game. The simpler design of the follow-up experiment did not complicate the “inoculation” with questions regarding personal experiences, editorial practices and challenges regarding freedom of speech and press.

Impact on attitudes towards credible news

The aims of the intervention to strengthen (a) resilience against disinformation and (b) democratic citizenship among teenagers may be hard to combine in the minds of students. Our findings that students did learn to appreciate reliable news after the peer-education intervention is an important finding in line with the second aim. Previous research has highlighted how *credibility importance* is an important mindset related to skills of civic online reasoning. Students rating it extra important to have access to credible news are also skilled at sourcing, evaluation evidence, and corroborating news (Nygren & Guath, 2019, 2021). This attitude towards credible news has been discussed as part of media habits which may separate news seekers from news avoiders (Strömbäck, Djerf-Pierre, & Shehata, 2013) which in turn is an important divide between active and passive citizens. The divide between students attitudes towards news may start early and be accentuated over the years in different educational settings, creating a gap between more and less active citizens (Lindell & Hovden, 2018; Shehata, Ekström, & Olsson, 2016). Credibility importance has also been discussed as related to science curiosity (Kahan, Landrum, Carpenter, Helft, & Hall Jamieson, 2017) which may be a key difference between people with an open mindset and other with motivated political reasoning. Credibility importance may also relate to students’ productive news habits (Nygren & Guath, 2019) and fruitful trust in sources (Haider & Sundin, 2019). Thus, the impact on credibility importance can be understood as important in light of educational designs aiming to promote democratic citizenship in a world saturated by digital news – making this finding very important to note and investigate further.

Negative impact on trust?

A majority of the students stated that the classroom intervention made them more suspicious against news in general. This may be interpreted as a problematic impact on core values in a democratic society. However, our results regarding trust and the importance of access to credible news point in the opposite direction. Students trust in media, politicians and researchers was not affected by the intervention. Nor did it affect students' ratings of credible control tweets or views on the importance of freedom of expressing opinions – even extreme, freedom of media, speech and press. And, as mentioned above, it did have a significant positive impact on student attitudes towards credible news. The risk of promoting a liar's dividend (Chesney & Citron, 2019) where powerful people may smear credible news as fake does not seem to be evident. Findings rather point towards a change towards an awareness of how misinformation is common and therefore it is central to follow credible news. We also found that students in the peer-education classroom setting were better at identifying the misleading tweet directed at discrediting mainstream media. This may also indicate that they learned to appreciate established news media more.

Design challenges and future research

The iterative process of designing, piloting, evaluating, testing, redesigning, testing again, and evaluating to redesign is central in this study. As underscored by advocates of design research, we base our design research on “prior research and theory and carried out in educational settings, seeks to trace the evolution of learning in complex, messy classrooms and schools, test and build theories of teaching and learning, and produce instructional tools that survive the challenges of everyday practice” (Shavelson et al., 2003, p. 25). What we find it that the complex and messy classroom situation in urban schools with peer-educators may have a mixed impact on students' abilities to learn about manipulative strategies. To rule out the impact of students backgrounds we had to do a follow-up online intervention.

We also find that this design with a mix of online games and peer-educators directing teenagers to consider filter bubbles, editorial challenges and issues linked to the freedom of speech and press may support students' constructive mindsets regarding the importance of access to reliable news. Thus, implementing an evidence-based game against misinformation is not an automatic success. We find it possible that using a game like this in the middle of a three-hour peer-education effort problematizing related issues of democracy and news media may distract students' attention and make it harder for them to learn. One way of addressing this would be to rearrange the order of lessons (see Appendix A, Table A3). Starting with lesson two and the Bad News Game without personal stories can provide a similar and more impactful experience in line with the online experience. It is also important to safeguard the positive impact on students' appreciation of credible news. This may relate especially to lesson three and classroom discussions about the editorial process and issues linked to freedom of speech and press. It may be that personal stories and discussions about filter bubbles distracted the students. We speculate that peer-education useful to promote constructive attitudes regarding drug use and smoking may distract students from the content of the teaching and learning about disinformation. Students did learn constructive attitudes, but not skills to navigate misinformation. A design promoting both could be investigated in another design cycle, starting with an updated game with more explicit instructions, followed by a second lesson focused on the editorial process and democratic values.

In sum, going to urban classrooms we find challenges in implementing the Bad News Game in classrooms and possibilities to impact students' constructive attitudes regarding credible news. Our study highlights the importance of evaluating the impact of educational interventions in a world where there is a loud call for more education against misinformation.

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Appendix A

Table A1 Pilot survey questions

1. What is the name of your school?
2. May we use your answers for our research?
3. Could you provide an example of what people or groups do to spread false information/fake news online?
4. How good are you at a. critically evaluating information online b. finding information online Answer categories [very bad – bad – OK– good – very good]
5. How much information online do you find credible? Answer categories [none – a little bit – about half – most of the information online – everything]
6. How important is it for you to read credible news online? [Slider not important – very important]
7. What is your gender? Answer categories [Man – Woman – Other – I’d rather not say]
8. Do you speak multiple languages at home? Answer categories
9. How much trust do you have in... a. Friends? [very little – very large] b. Strangers? c. Family? d. Media? e. Politicians? f. Researchers
10.-20. Even questions: ‘press OK if you read the tweet’ [technicality because of SurveyMonkey functionality regarding imagery]. Uneven questions ‘How credible do you find this tweet?’ Answer [slider not credible – very credible]
21. How important are the following freedoms for you? a. The freedom to express an opinion, even if it’s extreme b. The freedom for media to write what they want c. The freedom of expression d. The freedom of the press
22. How well do you understand... a. The way media works and chooses what news it publishes b. The way social media selects content for my feed
23. Are you filling out this survey before or after the Under Pressure sessions a. I am filling out this survey before the Under Pressure sessions b. I am filling out this survey after the Under Pressure sessions
24. Did the Under Pressure game cause you to distrust online media more than before? a. A lot b. Quite c. A little bit d. Not at all Why? [open space]
25. To what extent do you agree with the following statements a. The level of the Under Pressure classes was absolutely right – not too low, not too high b. I learned interesting new things during the Under Pressure classes c. I enjoyed the Under Pressure classes Answer categories [Strongly disagree, disagree, neutral, agree, strongly agree]

The following table provides an English translation of the tweets assessed by the respondents in questions 10 – 20

Question no	Author of tweet [profile bio]	Tweet
10-11	Warren Buffett [Billionaire, investor, friend]	Investment advice: only buy stock that makes you happy
12-13	Dr. Tom Lee [Professor in Modern Art]	As an academic/scientist, I do not believe there is enough proof to claim that humans can cause climate change
14-15	SusanP [retweet does not equal recommendation]	Medical students follow only 5 hours in education in nutritional and dietary sciences. Therefore never trust the nutrition advice from your GP.
16-17	Raw News At 1 NL (live the unfiltered news to your screen)	Scientists discovered the solution to green house gas effect years ago, but are not allowed to publish it, a new report claims
18	NextGlobal	UN report: world wide resurgence of extreme left groups damages world economy
19	International Post Online NL (online channel for news updates)	The mainstream media has been caught on so many lies, that they cannot be viewed as a legitimate news source #FakeNews
20	Daily Web News NL (daily updates on politics and more)	The bitcoin currency exchange rate is being manipulated by a small group of rich bankers #ResearchNow

Table A2 Survey questions and items in the classroom intervention

1. Would you like to contribute to research by responding to this questionnaire?
2. Please write the code given to you by your educator
3. What is your gender?
4. Do you follow news in multiple languages?
5. How important is it for you to read credible news online?
6. How much trust do you have in... a. Friends? b. Strangers? c. Family? d. Media? e. Politicians? f. Researchers
7. How important are the following freedoms for you? a. The freedom to express an opinion, even if it's extreme b. The freedom for media to write what they want c. The freedom of expression d. The freedom of the press
8. How well do you understand... a. The way media works and chooses what news it publishes b. The way social media selects content for my feed
Post-survey question: Did the education make you distrust news media more? Yes/No Please justify your response

Tweets presented in randomized order in survey and follow up.

Item name	Tweet
Emotion	Parents Weekly: NEWS ALERT Baby formula linked to horrific outbreak of new, terrifying disease among helpless infants. Parents despair
Impersonation	HBÖ: Next year there will be a new final season of #GameOfThrones season nine!
Discredit	International Post Online: The mainstream media has been caught on so many lies, that they cannot be viewed as a legitimate news source #FakeNews
Conspiracy	Daily Web News: The bitcoin currency exchange rate is being manipulated by a small group of rich bankers #ResearchNow
Trolling	Quad Media: Another shark loan for developing countries @WorldBank #WorldOfExtortion #HumanBanking
Polarisation	Rapid Updates: The myth of equal IQ between leftwing and right-wing people exposed #TruthMatters
Control Russia	SvD: Russian influence on the American election may be more significant than four years ago
Control Huawei	SVT: Huawei will be stopped from participating in the Swedish 5G-expansion #svtnyheter

Table A3 Lesson plans for the classroom intervention

Lesson 1 Introduction & opinion bubbles

1. Introductory game – 15 min
2. Online and offline filter bubbles – 20 min
 - Instagram-bubble exercise
 - Personal story about one-sided opinion forming/ offline filter bubble
3. Game – 10 min
4. Rounding off – 5 min

Lesson 2 Disinformation!

1. Looking back – 5 min
2. Difference between fake news & disinformation
3. Bad News Game – 30 min
4. Personal story and thinking of ways to recognize disinformation – 8 min
5. Rounding off – 7 min

Lesson 3 Media & you!

1. Looking back and introduction – 5 min
2. Editorial game – 15 min
3. Freedom of expression and press freedom: boundaries? – 15 min
4. Are you in? – Activate the students! – 5/10 min
5. Rounding off – 5 min

Table A4 Outline editorial exercise/game

In the editorial game, students learn how traditional media work
Insights into the at times difficult decisions that journalists face

Activity

- The classroom simulates an editorial board that reports on a very serious event: a boy's suicide
- The classroom is divided into two groups and has to make a decision under time pressure
- Read the options
- One minute internal discussion in the group, one and a half minute between the groups
- Then click the button

Example: Setting and first options of the editorial exercise

It is 10AM and the editorial board receives a message that a 15-year-old boy has committed suicide. The boy from The Hague was already missing for a week. This news is very gripping and has to be presented in a sensitive manner to the outside world. On the one hand, it is a very sensitive issue for the boy's relatives, friends and his school. On the other hand, you do not want to convey the message that committing suicide is a right thing to do. In general, journalists therefore report on suicide in a rather reserved manner. At the same time, it remains unknown why the boy committed suicide. Nevertheless, the (name school)-news wants to break the news.

Option 1

Which headline do you choose?

- (a) Missing boy, 15 years old, is found dead, cause is unknown
- (b) Missing boy, 15 years old, commits suicide, still unclear why

Option 2

Although the editorial board was reserved in naming the suicide, other news papers, the competitors, were not. Therefore, it now looks as though you as an editorial board did not do your work properly. Moreover, it has gotten clear in the meantime that the boy had been bullied for quite some time. On social media several films are shared where you can see how the boy was bullied and even assaulted. The family has made it clear that they do not want the films to be shared anymore.

(a) The films provide insight into the situation of the boy and the cause for his suicide: bullying. This is why you choose to share the films.

(b) The editorial board understands this, as the films contain very heavy images. At the same time, the bullies are clearly visible in the films so that there is a chance that they will be victims of revenge. This is why you choose not to publish the films and call on people to stop sharing them on social media. The fact that the boy was bullied, is discussed in a sensitive manner.

Appendix B

Table B1. Misleading tweets supposed to be determined as less reliable after intervention. Paired Samples Wilcoxon test.

			Statistic	p	Mean difference	SE difference
Emotion-Pre	Emotion-Post	Wilcoxon W	113.0 ^a	0.685	-3.96e-5	0.269
Trolling-Pre	Trolling-Post	Wilcoxon W	98.5 ^b	0.290	1.000	0.291
Conspiracy-Pre	Conspiracy-Post	Wilcoxon W	27.5 ^d	0.998	-1.500	0.290
Discredit-Pre	Discredit-Post	Wilcoxon W	227.5 ^c	0.039	1.000	0.331
Impersonation-Pre	Impersonation-Post	Wilcoxon W	54.0 ^f	0.868	-1.000	0.420
Polarisation-Pre	Polarisation-Post	Wilcoxon W	60.0 ^g	0.978	-0.500	0.301

Note. H_a Measure 1 > Measure 2

^a 8 pair(s) of values were tied

^b 12 pair(s) of values were tied

^d 10 pair(s) of values were tied

^c 5 pair(s) of values were tied

^f 13 pair(s) of values were tied

^g 9 pair(s) of values were tied

Table B2. Credible tweets supposed to be determined as reliable also after intervention. Paired Samples Wilcoxon Test

			Statistic	p	Mean difference	SE difference
Control-Huawei-Pre	Control-Huawei-Post	Wilcoxon W	36.5 ^a	0.093	-1.000	0.268
Control-Russia-Pre	Control-Russia-Post	Wilcoxon W	100.0 ^b	0.747	0.500	0.370

Note. H_a Measure 1 < Measure 2

^a 15 pair(s) of values were tied

^b 12 pair(s) of values were tied

Table B3. Misleading tweets supposed to be determined as less reliable after intervention. Paired Samples Wilcoxon Test

			Statistic	p	Mean difference	SE difference
Trolling-Pre	Trolling-Post	Wilcoxon W	31.00 ^a	0.037	1.500	0.646
Polarisation-Pre	Polarisation-Post	Wilcoxon W	5.00 ^b	0.573	0.255	0.447
Emotion-Pre	Emotion-Post	Wilcoxon W	23.00 ^d	0.071	2.353	0.763

Table B3. Misleading tweets supposed to be determined as less reliable after intervention. Paired Samples Wilcoxon Test

			Statistic	p	Mean difference	SE difference
Impersonation-Pre	Impersonation-Post	Wilcoxon W	7.50 ^c	0.554	0.000	0.994
Discredit-Pre	Discredit-Post	Wilcoxon W	16.00 ^d	0.398	0.170	0.882
Conspiracy-Pre	Conspiracy-Post	Wilcoxon W	19.50 ^d	0.197	2.000	1.059

Note. H_a Measure 1 > Measure 2. N=30

^a 2 pair(s) of values were tied

^b 6 pair(s) of values were tied

^d 3 pair(s) of values were tied

^c 5 pair(s) of values were tied

Table B4. Credible tweets supposed to be determined as reliable also after intervention. Paired Samples Wilcoxon Test. Control Condition: Game Only

			Statistic	p	Mean difference	SE difference
Control-Huawei-Pre	Control-Huawei-Post	Wilcoxon W	6.00 ^a	0.198	-1.00	0.680
Control-Russia-Pre	Control-Russia-Post	Wilcoxon W	18.00 ^a	0.955	3.00	0.819

Note. H_a Measure 1 < Measure 2. N=30

^a 4 pair(s) of values were tied

Table B5: Bayesian T-Test of Experiment in Class Room Condition: Game and Peer Education

			Statistic	±%
Emotion-Pre	Emotion-Post	Bayes factor ₁₀	0.196	1.28e-4
Trolling-Pre	Trolling-Post	Bayes factor ₁₀	0.214	7.91e-5
Conspiracy-Pre	Conspiracy-Post	Bayes factor ₁₀	15.786	1.93e-8
Discredit-Pre	Discredit-Post	Bayes factor ₁₀	0.828	5.62e-8
Impersonation-Pre	Impersonation-Post	Bayes factor ₁₀	0.370	4.92e-5
Polarisation-Pre	Polarisation-Post	Bayes factor ₁₀	1.317	4.67e-8
Control-Huawei-Pre	Control-Huawei-Post	Bayes factor ₁₀	0.391	6.18e-5

Table B5: Bayesian T-Test of Experiment in Class Room Condition: Game and Peer Education

			Statistic	±%
Control-Russia-Pre	Control-Russia-Post	Bayes factor ₁₀	0.223	6.18e-5

Table B6: Bayesian T-Test of Experiment in Follow Up Condition: Only Game

			Statistic	±%
Trolling-Pre	Trolling-Post	Bayes factor ₁₀	1.084	3.80e-5
Polarisation-Pre	Polarisation-Post	Bayes factor ₁₀	0.309	7.13e-5
Emotion-Pre	Emotion-Post	Bayes factor ₁₀	1.057	3.65e-5
Impersonation-Pre	Impersonation-Post	Bayes factor ₁₀	0.310	7.07e-5
Discredit-Pre	Discredit-Post	Bayes factor ₁₀	0.309	7.13e-5
Conspiracy-Pre	Conspiracy-Post	Bayes factor ₁₀	0.417	4.42e-5
Control-Huawei-Pre	Control-Huawei-Post	Bayes factor ₁₀	0.538	2.34e-5
Control-Russia-Pre	Control-Russia-Post	Bayes factor ₁₀	0.918	8.44e-5

Table B7: Paired Samples T-Test Credibility importance

			Statistic	p
cred_imp.pre	cred_imp.pst	Wilcoxon W	24.0 ^a	0.035

^a 13 pair(s) of values were tied

Table B8: Credibility importance Descriptives

	N	Mean	Median	SD	SE
cred_imp.pre	28	3.96	4.00	1.036	0.196
cred_imp.pst	28	4.39	5.00	0.786	0.149

Table B9: Paired Samples T-Test importance of freedom of opinion, media, speech and press

			Statistic	p
frdm_opinion.pre	frdm_opinion.pst	Wilcoxon W	49.0 ^a	0.441
frdm_media.pre	frdm_media.pst	Wilcoxon W	50.0 ^b	0.208
frdm_speech.pre	frdm_speech.pst	Wilcoxon W	12.0 ^d	0.824
frdm_press.pre	frdm_press.pst	Wilcoxon W	28.0 ^c	1.000

^a 16 pair(s) of values were tied

^b 11 pair(s) of values were tied

^d 21 pair(s) of values were tied

^c 17 pair(s) of values were tied

Table B10 Ratings of importance of freedom of opinion, media, speech and press - pre and post intervention

	N	Mean	Median	SD	SE
frdm_opinion.pre	28	4.29	5.00	1.213	0.2292
frdm_opinion.pst	28	4.11	4.50	1.197	0.2262
frdm_media.pre	28	3.79	4.00	1.101	0.2080
frdm_media.pst	28	4.11	4.00	1.031	0.1948
frdm_speech.pre	27	4.81	5	0.396	0.0762
frdm_speech.pst	27	4.78	5	0.506	0.0975
frdm_press.pre	27	4.67	5	0.555	0.1068
frdm_press.pst	27	4.67	5	0.620	0.1194

Table B11: Students ratings of teaching and learning after classroom intervention

	Level of teaching	Fun to participate	Learn new interesting things
N	25	25	25
Missing	5	5	5
Mean	4.24	4.20	4.20
Median	4	5	5
Standard deviation	1.61	1.85	1.71
Minimum	1	1	1
Maximum	7	7	7