

A tale about facts and opinions: The impact of a drama intervention on middle-school students' information literacy.

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Abstract. Today, huge amounts of data are produced, collected, and presented in all kinds of contexts. The ability to critically examine and evaluate information and arguments in relation to empirical evidence is often referred to as information literacy. It is of utmost importance that students are adequately scaffolded to develop this ability, to be able to become democratic citizens. The study presented combines learning science and drama to explore whether this approach can make 6 grade students more aware of certain aspects of information literacy, such as false balance, the burden of proof, and filter bubbles. Half of the students watched a play and participated in a pedagogical follow-up before answering a questionnaire. The other half answered the questionnaire before the intervention. Results show that students watching the play had grasped the core of the more tangible questions, writing more elaborated and relevant answers than students in the control group.

Keywords: Information literacy, drama intervention, middle school, fake news

1 Introduction

The twenty-first century is sometimes referred to as the information era. The period is not only characterized by a huge increase of information flow but also by an explosion of different information sources. Information is spread in a variety of contexts, in different formats and through different channels. In this way, people nowadays encounter 'news' about everything from the latest fashion to climate change not only by reading traditional newspapers but also by frequenting social media and online forums and websites. To a large extent the increased exposure to information depends on the emergence of digital platforms, which provide an easy and fast access to information. Much of what is communicated does not, however, undergo any review or scrutinizing. Opinions are presented as facts, and opinions with minor elements of facts may be presented as the grand truth. Many youths are caught in a tangled mess of facts and opinions and hence need updated skills as to how to orient in this information overload [1, 2]. The latest PISA investigation shows that only about half of Swedish youths understands the difference between fact and opinion [3], a result that is also reflected in other European countries.

Directly related to this is the essential goal of schooling and education to give young people support to grow and develop into adult human subjects, able to meet their surrounding in a qualified way [4]. This includes being able to critically examine and evaluate information and to evaluate arguments in relation to empirical evidence.

Looking in more detail, this requires abilities such as: i) being able to distinguish between a conclusion that fits with empirical data and one that does not, ii) having an understanding of the concept of research and of how research is conducted, iii) understanding how data can be used to create a narrative or present an argument, and iv) knowing how to critically examine sources but also what sources to trust. Such abilities are often referred to as *information literacy* and is by the Association of College & Research Libraries summarized as having the ability to locate, evaluate and effectively use the needed information [5]. UNESCO also refers to these competences as *media and information literacy (MIL)*, which in turn relates to the term *civic literacy* [6]. According to [7], civic literacy can be described as "an approach to learning that emphasizes the knowledge, skills, and dispositions necessary for active and engaged citizenship"

In this paper, we exclusively use the term *information literacy* for all the competences described above. Being *information literate* is an essential aspect of being able to participate in a modern society and make well-informed decisions, and it is also directly linked to lifelong learning, critical thinking and learning new concepts in education [8]. Individuals with a high degree of information literacy run a lower risk of being misled or deceived, as well as a lower risk of themselves creating misunderstandings or spreading misinformation. Hence, information literacy should be highlighted in school curricula. Only exposing students to a great deal of information will not make them informed citizens. They need to learn how to use information effectively, and education is here one of the key ingredients in defeating disinformation.

There are studies that have shown that information literacy can be taught [9-13] but the topic is still understudied, and there is a call for more research on how education can support information literacy. In this context, the aim of the study at hand is to evaluate a project that combines learning science and drama pedagogy to inform 6th grade students about the subject. More specifically, the project's aim is to investigate if such an approach can make students in the 6th grade more aware of certain aspects of information literacy, such as confidence in what information can be trusted and not, as well as separating proper scientific procedures from less adequate ones. The reasons for choosing this particular age group are three folded: First, there are cumulative benefits of learning something early on in life, since this knowledge can be used for many years to come. Second, the reason for not choosing younger students is that around this age (that is, 11-12 years) children undergo a huge cognitive development; before this age, children are less well equipped to reason and think about these topics [14, 15] and third, most 11–12-year-old children in Sweden are exposed to different types of information on a daily basis via computers and mobile phones. Consequently, the dangers of trusting 'fake news' – as well as not trusting trustworthy information when browsing social media and the internet - can't be highlighted enough.

2 Background

2.1 Young students' information literacy skills

Overall, the body of research on students' capacity to navigate in the information landscape is growing, especially when it comes to their ability to evaluate digital information and critically examine online sources [16- 21]. The results of these studies reveal that children, as well as many young adults and fully grown-ups, struggle when it comes to information literacy.

As an example, a large study targeting over three thousand American high-school students revealed that two thirds of the students were unable to tell the difference

between news and advertisements, and that only 4% of the students questioned why ties between a climate change website and the fossil fuel industry might lessen that website's credibility [16]. These findings are in line with a Swedish study by Nygren and Guath [20], where 88% of the participants struggled to identify news in contrast to ads in common digital newspapers. These authors also conclude that the teenagers' view of their own ability to evaluate online information did not correspond to their actual abilities. In another American study, investigating students' civic online reasoning, McGrew and colleagues [19] stated that both middle-school students as well as students in high-school and college, rarely ask who creates and produces online materials. Similar results can be found in Gross and Latham [22] who showed that first year college students tend to overestimate their information literacy skills.

Being information literate also involves the ability to reconsider one's own beliefs, something that has proven difficult [23, 24]. Only searching for information confirming what you already think/know increases the risk of you ending up in so called 'digital echo-chambers'. This danger increases with today's social media algorithms that feeds the viewer with feeds similar to ones already liked, something that runs the risk of creating 'filter bubbles' [25] something that according to Boyd [26] also seems true for younger people. But interestingly, the same patterns do not seem to be found among Swedish teenagers [27].

In all, these studies point at a need for structured learning and practice on how to educate students to engage with web-based information. However, literature on how to promote and strengthen younger students' information literacy skills is more uncommon, and especially so when it comes to increasing their ability to notice and handle non-scientific arguments. One exception is [28] who trained 4th and 5th graders on a framework with the purpose of improving students' awareness of the need to and their ability to evaluate websites. Their results showed that students who were trained were more aware of the need to evaluate information on the internet for credibility and were better able to evaluate the trustworthiness of websites on multiple dimensions. However, we believe this ought to be further addressed, since such abilities are considered as core components of information literacy.

2.2 Using drama as a classroom activity

As mentioned above, our study combines learning science with drama- pedagogy in order to ground and contextualize information literacy teaching. Using drama in regular classroom instruction is not a common practice, and even less so to have professional actors visiting the classroom. There are however studies that have looked at the impact of drama pedagogy in classrooms and Lee and colleagues [29] report in a meta-review that drama-pedagogy has significant effects on many outcomes, such as achievement, attitudes and 21st century skills. But they also report that this pedagogy is most efficient when used for story comprehension rather than to teach a new skill, embody new ideas or extend learning. Smith and Herring [30] further discuss how drama used in classrooms can provide a means for learning by living through an experience and event.

What is incorporated in drama-pedagogy can vary but often it involves a teacher, a researcher, or a teaching artist who guides students through a learning experience with the help of, for example, theatre games, imagination exercises or role-play [29]. When using drama-pedagogy, the student often takes an acting role, something that has proven beneficial to for example promote literacy learning [31], to better understand an historical happening [32] or to increase the amount and depth of science inquiry as well improving scientific writing [33]. Further, it has been shown that the use of drama in teaching can help children with a language disorder to improve and maintain social and oral language skills [34].

Using drama to teach information literacy is to our knowledge uncommon. In general information literacy teaching involves traditional methods in which students receive information from their teacher or through online search. There are however some exceptions. For example [35] used drama-pedagogy to support information literacy development in students by letting students both write, act and direct argumentative dramatic scenes with the teacher's help. Even though it was mainly the students' subjective experiences that were evaluated in this study, the results show that the students showed an interest in this type of pedagogy and that they held that it gradually stimulated their thinking and also helped to increase their abilities to search for relevant information and use it in their writing.

In this paper we refer to drama-pedagogy as the artistic representation to achieve an educational purpose [36]. In our study this had the form of a play performed by a professional theater group in combination with a pedagogical follow-up in which the students participate in different roles (see method section below). The play is built around several narratives and uses the power of storytelling to convey its messages. Storytelling has well known strengths that a traditional textbook in school often lack. It is well established that a good way to capture someone's attention is to tell a story, and the power of storytelling seems to work in school as well [37]. Willingham [38] argues that the art of storytelling in classrooms works because we, for several reasons, understand and remember stories quite well. One reason is that they follow a familiar structure, with well-defined beginnings, events and ends. Another is that stories often focus on people and relations. Different types of stories are also something we can relate to since most of us grow up hearing them. Stories also evoke emotions as well as make us reflect upon our own values, problems, and ideas.

In this project we wanted to combine storytelling and science, and with this pilot study we explore whether this combination can contribute to an increased awareness and understanding of information literacy.

3 Method and material

3.1 Method

The study is part of a larger project addressing 6-7 grade students' awareness and understanding of data- and information literacy and how this awareness can be scaffolded. The larger project encompasses a classroom discussion of data literacy around a set of video clips, a drama performance and a pedagogical follow-up including a set of drama-based exercises. The project was conducted by our research group together with a professional theater group called *The Fairytale House Theater* (*Teater Sagohuset* in Swedish). One of the theater's specialties is live performances in classrooms or other school-based locations. The present study focuses on how attending to the play and participating in the pedagogical drama-based follow-up interactions, as measured through a free-text follow-up questionnaire, possibly affects students. Neither the video-clips nor the pre/post-test results will be discussed in this article (for results regarding pretest we refer to [39]).

3.2 Material

The play. The play was written by a professional playwright in collaboration with a researcher in cognitive science/learning science who provided expert input regarding information literacy and learning. The play was also directed by the playwright and performed by *The Fairytale House Theater*. The storyline builds upon how the growth

of Internet has affected news and media reporting. It visualizes, for example, the blurring of opinions and facts and how easy it is to get lost in misleading information. The aim is to sensitize the importance of being able to separate fact from opinion, understanding what information to trust and why, and having a basic understanding of what science is and is not (see Figure 1 and 2).



Fig. 1. One of the actors talking about fake news and how they trigger emotions such as doubt. (Photo by Emma-Lisa Pauly.)



Fig. 2. The actors portray the feeling of being left alone with your thoughts and feelings, trying to navigate in today's information landscape. (Photo by Emma-Lisa Pauly.)

The play revolves around three main characters (shown in Fig. 2.) and addresses specific topics related to information literacy. *Fact resistance*: What can happen when someone is lost in the world of skepticism and is only receptive to information that strengthen the person's already existing opinion; how can we support and talk to a person in that situation? *False balance*: What is problematic with a TV debate with

two 'experts' invited to talk on the same terms, where one communicates what an overwhelming majority of all scientists in the area agree on, while the other communicates an opposite viewpoint, only supported by a few? *Fake news*: What does this concept mean, and how does the filtering of our news feeds lead us into filter bubbles? *Russell's teapot*: Why is it up to the person making a statement to present evidence for it and not for someone else to present evidence against it? *Science & Research*: What is scientific evidence, what are the basics of the scientific method and what reasons are there to trust science (as opposed to individual researchers or mere laymen)?

Pedagogical follow-up. After having seen the play and having a break of approximately 40 minutes, the class met up with the actors again. It was time for the pedagogical follow-up in which topics from the play were enacted and discussed. The follow-up was moderated by a theater pedagogue guiding both actors and students. Among the different elements involved in the follow-up was that of engaging the students in improvisational theater where the students created a short story and instructed the actors to perform it, by telling the actors how to act and what to say. For example, one story revolved around the communication between a father and his daughter, being at the opposite ends of an opinion, and their difficulties in having a conversation. Another element consisted in discussions of topics from the play such as: "How difficult is it to know if something is fact or a lie on the internet?"; "Can science can be trusted or not?"; "What differentiates a democracy from a dictatorship?". Further, one activity evolved around mini plays in which students two and two enacted different roles (provided by the theater pedagogue) in order to discuss different themes. Classes were also invited to the floor to take a stand in different questions, such as "Is democracy important? The drama pedagogue then drew an imaginary line on the floor and the students were asked to stand somewhere on the line, where one end represented "yes, absolutely, very important" and the other end represented "not at all important" (for this question). The different clusters of students then led to further discussions on the topic. The pedagogical follow-up took place in the same location as the play. All students were encouraged to talk, discuss and participate, sometimes in smaller groups and sometimes in full class.

Free text questionnaire. The questionnaire contained four free text questions each covering a topic addressed in the play.

Q1: Two people meet in a television debate: (i) a person working for a company that manufactures a new herbal medicine against hypertension, and (ii) a researcher, specialist in this field, who warns for this new medicine. Who could be trusted and why?

Q2: If you meet someone skeptical of the measles vaccine, what are your recommendations for how to talk to such a person?

Q3: You meet with someone who says there are aliens and then tells you that you "cannot prove this to be false". How do you handle this statement?

Q4: Why could it be problematic that an app like for example TikTok choses what type of feeds you are shown?

The four questions were presented in random order for each student and the students were told to answer at least two of them.

3.3 Participants and procedure

Seven 6th grade classes (145 students; 72 girls and 73 boys) from three different schools in the south of Sweden participated in the study. All three schools were situated in mid- to high socio-economic areas. Four of the seven classes were assigned to the experimental condition and three to the control condition. Importantly, both conditions were present at all three schools.

The overall procedure was based on 3 separate classroom sessions and were designed as follows: At the first session, the researchers briefly presented themselves and the study. The students (in both conditions) thereafter took a pre-test on information- and data literacy, whereupon they watched and discussed three short video-clips covering different aspects of data literacy (not presented in this study). At the second session, the experimental classes (*Play*-condition) took part in the drama intervention (watching the performance and taking part in the pedagogical follow-up), while the control classes (*NoPlay*-condition) conducted a post-test (not presented in this study) and answered the free text questionnaire. The third session was the same as the second one, although the classes were reversed (that is, the students that hadn't taken part in the drama intervention did this, and the other students filled in the post-test and the questionnaire, see Figure 3).

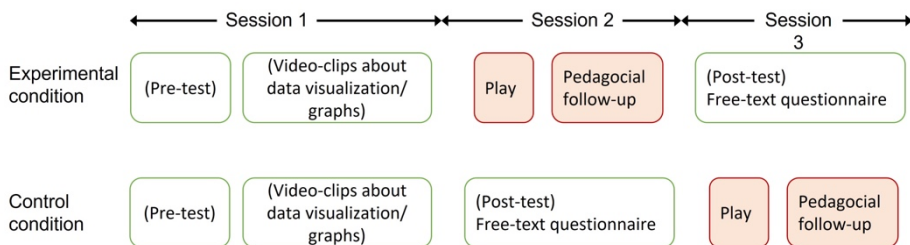


Fig. 3. The total experimental procedure, with the drama intervention-part marked in red.

4 Results

In sum, 126 students (68 in the experimental condition and 58 in the control condition) responded to the questionnaire by answering at least two of the four free text questions. To evaluate whether the play had an impact on the students' awareness of the difference between facts, opinions and evidence-based research, the free text answers were both quantitatively and qualitatively analyzed. First, the response rates per school and question (Q1-Q4) were calculated as well as the number of words per student, hypothesizing that the experimental classes should produce more text and have a higher response rate. Two researchers then made a thematic analysis of the text content and categorized the answers from each student into 10-14 categories per question. (As an example, question Q3 about aliens ended up with 10 categories while question Q4 about the TV debate had 14 categories). The categories were agreed upon after a first overview of the data and the actual categorization was done independently on anonymized datasets. The categorization of the text content was highly reliable (48 items, Cronbach's $\alpha = .97$). Table 1 presents response rates and word counts per condition and school; Table 2 presents response rates and word counts per condition and free text question. (When calculating response rates, the 'no response' alternative

encompass blank answers, ‘don’t know’-answers, and irrelevant answers and comments.)

Table 1. Response rates and written words per student per conditions (NoPlay/Play) and school (A-C).

School	Condition	N	Response Rate	Words/Student Mean (SD)
School A	NoPlay	18	54%	57 (46)
	Play	17	80%	102 (79)
School B	NoPlay	20	52%	74 (46)
	Play	16	51%	57 (31)
School C	NoPlay	20	69%	71 (39)
	Play	35	64%	71 (52)
Σ	NoPlay	58	59%	
	Play	68	65%	

As shown in Table 1, only the experimental class from School A (a high-performing school in a university town) had a general increase in response rates and number of written words after the intervention. The results from the other two schools are not as clear.

Table 2. Response rates (%) and written words per student (Mean and SD) per condition (NoPlay/Play) and question (Q1-Q4).

Cond	Q1 Tv debate		Q2 Vaccine		Q3 Proving Aliens		Q4 TikTok	
	Resp Rate	Words M (SD)	Resp Rate	Words M (SD)	Resp Rate	Words M (SD)	Resp Rate	Words M (SD)
NoPlay	60%	11 (16)	38%	16 (17)	55%	24 (19)	79%	67 (43)
Play	56%	19 (27)	57%	18 (18)	66%	25 (23)	74%	43 (58)

Next, looking at the separate questions (Table 2), most students chose to respond to question Q4 (*TikTok*) while the play and its pedagogical follow-up did not seem to have a positive impact on neither the response rates nor the number of written words. The largest difference between response rates was found for question Q2 (*Vaccine*). 57% of the students in the experimental condition (Play) wrote an answer for this question compared to only 38% in the control condition (NoPlay).

Finally, turning to the difference in response rates and number of written words between schools and questions (Figure 4), School A is the only school where the experimental condition seems to benefit from the intervention (compared to the control condition at the same school). Also here, Question Q2 (*Vaccine*) stood out, being the only question where all experimental classes had a higher response rate than the controls.

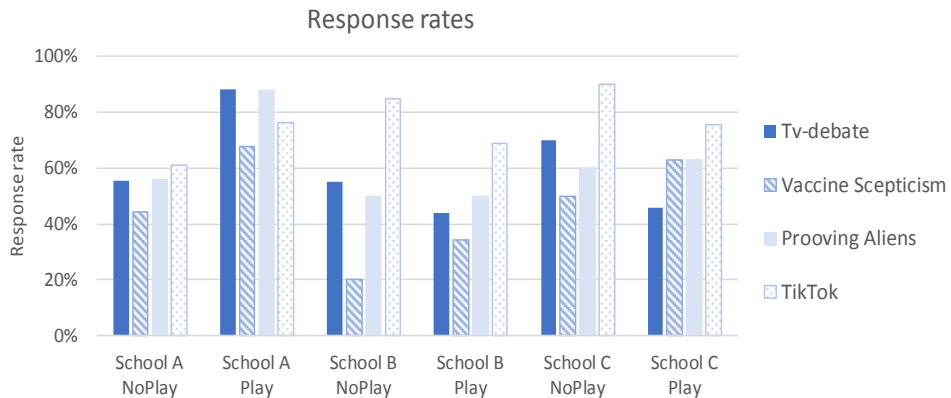


Fig. 4. Response rates per question (Q1-Q4 separated on school (A-C) and condition (NoPlay/Play)).

4.1 Q1: False balance: TV debate between a researcher and an entrepreneur

This was the most answered question for the experimental class in school A, where 88% of the students chose to respond to it (Figure 2). These students also sometimes wrote quite long responses, often arguing that the researcher ought to have more knowledge on the subject and/or that the entrepreneur could be biased due to economic interests.

“I believe that the researcher, who is a specialist on this subject, ought to know best and I would trust him/her without hesitation. [...] Also, perhaps the entrepreneur only wants to sell the new product. [...] We should trust [the researcher] since a specialist doesn’t make money from/by warning about the medicine, but the entrepreneur makes money by selling it.” (Student, School A, experimental condition.)

Other students elaborated on the risks for the entrepreneur to try to sell something that is broken or dangerous.

“You should be able to trust the company, because if a company lies about their product, they might have to pay damages to people buying it. [...] This have happened to huge companies, like Redbull, who had to pay a lot of money to people who actually believed that “Redbull gives you wings” [Swedish commercial]. But, if a researcher warns about something, it would be good to double check whether other researchers has reached the same conclusion before buying the medicine.” (Student, School A, experimental condition.)

In sum, 56% in the experimental condition and 60% in the control condition replied to this question. 48% of the students (47% from the experimental condition and 50% from the control condition) responded that the researcher was the most reliable party. A minor part (2% and 3%, respectively) responded that you should trust the entrepreneur and 7% (both conditions) answered “both” or “none”.

The most common argument (31%) for trusting the researcher was that they probably had more knowledge of the subject or were better educated than the entrepreneur while a smaller proportion of the students (6%) argued that a researcher probably had performed actual experiments or represented a larger research community (6%).

Only a few students pointed out the specific problem with *false balance*. In the play, the actors presented a biased TV debate between two scientists discussing climate change with one scientist presenting facts about climate changes and the other scientist denying their existence. Next, in the play, they discussed the problem of false balance with scientists presenting evidence for climate change being backed up by more or less the whole research community in contrast to the scientists reasoning against climate change. Only three students, all in the experimental condition, pointed to this, arguing that “you should trust the researcher(s), because there are (probably) more of them.”

4.2 Q2: Skepticism towards measles vaccine

Even though this was the question with the lowest response rate (57% for the experimental condition and 38% for the control condition), the intervention seemed to have a positive impact on its response rates for all schools. Most of the students (42% in the experimental condition and 29% in the control condition) suggested that one should persuade the skeptic by presenting facts, referring to research, or to tell them that measles is a dangerous disease.

“You can try to tell everything that’s positive about the vaccine, and perhaps mention if there is anything negative with it taking it. Then you can show that the advantages outweigh the disadvantages. Normally, only get a lite sick afterwards. The measles vaccine has been around for a long time, and it has been tested by many. Getting the measles is far more life-threatening than getting sick from a vaccine.” (Student from School A, control condition.)

Moreover, 7% in the experimental condition and 3% in the control condition also pointed out that you should listen carefully to the skeptic and speak calmly, not to put them off.

“You can talk about both advantages and disadvantages with the vaccine. You should also try to see it from the other persons point of view and listen to all the facts.” (Student, School A, experimental condition.)

This particular aspect, i.e., that emotions often have a great impact on our decisions and that you therefore should listen to sceptics and treat them with respect, was emphasized in the play when the character Sandra explains her anxiety towards the Covid-19 vaccine. Sandra believes the vaccine has not been tested enough, and she engages in online conversations with other vaccine skeptics who strengthens her beliefs. Her friend Torsten then asks her if she would refuse anesthetics during an operation and of course she answers “no”. By referring to all the other drugs Sandra normally accepts without hesitation, she finally understands that her fear of the vaccine is irrational. This particular way of argumentation was taken up by 7 students (5.5%), all in the experimental condition.

“You can explain to the person that a vaccine is like a medicine. For example, if you have a headache you take an Aspirin. Because you know that Aspirin is a good medicine that helps if you have a headache. It is the same thing with a vaccine. The vaccine doesn’t protect 100% but still, it is better to have, let’s say, 25% protection towards a disease than none at all.” (Student, School A, experimental condition.)

4.3 Russel’s teapot: “You can’t prove there aren’t any aliens”

Almost equaling question Q1 (*TV debate*), this question had the second highest response rate in the experimental class in School A, although this was the only school where the experimental class had a higher response rate on this question than the control class (88% vs 56%). In total for all schools, the response rate for the experimental condition was 66% and for the control condition 55%. A popular answer was to argue that there still is no evidence that aliens exist (46% in the experimental condition and 36% in the control condition), while 20% (21% and 19% respectively) pointed out that it was the person making the claim that should present proofs of their existence.

“I would say ‘No, I cannot disprove it, but you cannot prove it.’ There are people who have gone out in space, but I have never heard about aliens. Research shows that no one has found ‘aliens’ and when thinking about our technology, we should at least know if they exist.” (Student, School B, control condition.)

The experimental classes, however, more often discussed that there were no proofs either way for aliens existing or not (10% in contrast to 7% in control classes) while they were less keen to just dismiss a person believing in aliens (10% in contrast to 12% in control classes).

“That the person has watched fake news and believed it. The person himself does not know but thinks everything is true, though it’s only a lie.” (Student, School A, control condition.)

In the play, this topic was discussed by presenting the analogy with Russel’s teapot, showing that an argument like “you cannot disprove that Y does not exist” does not hold, since it’s not empirically falsifiable. Even if many students wanted more proofs for aliens existing from the person making the claim, only a minor part (8 from the experimental condition and one from the control condition) referred to this abstract way of reasoning.

“It is the person who makes a claim who has to prove it. It is not for me to prove it.” (Student, School A, experimental condition.)

4.4 The problems with TikTok filtering your feed

This was the most popular question to answer in School B and C with higher response rates for the classes in the control condition (85% in contrast to 69% for School B and 90% in contrast to 76% for School C). In total for all schools, the response rate was 74% for the experimental condition and 79% for the control condition. Even if many students (48% in the experimental condition and 33% in the control condition)

pointed out problems with the spreading of fake news and commercials, only a minor part (9% for both conditions) discussed the problem with getting filtered information that may narrow your view and understanding of different topics.

“TikTok can make us see bad things about a country that are not true, and then maybe you go around and tell this to others, and then they spread it further, and then you have spread a rumor that is not true, and TikTok can also show videos prohibited for children.” (Student, School C, control condition.)

In the control condition, 29% of the students (compared with 13% in the experimental condition) emphasized that TikTok could place ‘bad’ or ‘dangerous’ material in their feeds, which in turn could make you feel uneasy. In contrast, a considerable part of the students (13% in the experimental condition and 17% in the control condition) argued that TikTok’s filtering was a positive feature, protecting them from inappropriate materials and promoting videos and feeds that they usually like.

“No, this isn’t a problem because I don’t want to see disgusting things, only fun TikToks and interesting videos, and you can learn new things every day.” (Student, School C, experimental condition.)

The problem with filter bubbles in social media was only briefly mentioned in the beginning of the play, while the issues with fake news, fact resistance, cognitive bias, and conspiracy theories were more thoroughly debated. It was hard to find any responses specifically pointing out the problem with filter bubbles, and only 3 students in the control condition and 2 in the experimental condition focused on this particular issue.

“Because TikTok selects a personal feed based on what you often look at. Then you might not get an overall picture of everything that exist on, for example, TikTok.” (Student, School A, control condition.)

5 Discussion

Looking at response rates at a general level, the results indicate that only students at one of the three schools (School A) benefited from the intervention (i.e., the play and the pedagogical follow-up). Here, the experimental class responded to more questions (80% vs 54% for the control class) and also produced more answers in line with the content of the intervention. For the other two schools, response rates did not differ in these ways between conditions. Instead, students at these two schools seemed most keen to respond to questions that they were already familiar with, regardless of the play. It should also be noted that School A is a high performing school, while the other two schools have a larger proportion of medium and low performing students. It could be the case that this intervention was better suited for higher performing students who might have reached a higher level of abstract reasoning. Likewise, the students reading- and writing skills might influence their capacity to write suitable arguments.

The results also show that Q4, the question about TikTok and filtering of feeds, was the question most replied to, both in terms of response rates and written words

per student. This is not surprising as this probably is the question that most students easily can relate to. The actual usefulness of measuring the number of written words per student can be discussed. This measure can perhaps tell us something about the impact of the play but could just as well reflect the overall performance level in a class. Even if our study used control classes and experimental classes from the same school, the average achievement levels between classes in the same school can still vary, effecting the result. One way to deal with this would have been to relate the free-text responses to the results on the pre-test. However, since this test mainly reflected the students' capacity to interpret graphs and data visualizations, this alternative was rejected.

Examining the four questions one by one, it seems as if some questions were more difficult to grasp than others. For Q1, the question about false balance in a TV-debate, many students (48 percent) held that it is the researcher that should be trusted, with most answers mentioning that the researcher should be trusted because s/he is an expert or specialist. Not all responding students widened their reasoning, discussing *why* the researcher is more trustworthy (e.g., her/his expertise and experience of experimental research or that he/she represents a larger research community). This is a bit troublesome, since they in one sense seem to focus more about *who* the person is making the claim and the role of this person, rather than reflecting about the underlying facts. This is not that surprising given that *source criticism* (*källkritik* in Swedish) is highlighted in the Swedish school curriculum and students in this age group are quite used to discussing and evaluating sources of various kinds. It is, however, one thing to be able to scrutinize and evaluate a message, claim, or narrative in relation to the source – and something else to be able to scrutinize and evaluate a message, claim, or narrative in relation to the underlying empirical data.

The same applies to Q3, the question about providing evidence and Russel's teapot, in that most of the students don't seem to grasp the whole concept of Russel's teapot which represents falsifiability. Many students mention that "I will not trust anything unless I can see it" and that "there are no proofs for either case". Only a very few students specifically mention that it is up to the person making a claim to provide the proof, rather than the other person to prove the incorrectness. The students who mention this are all part of the experimental classes, indicating that the play and the pedagogical follow-up may have had an effect on at least some students. Yet, one might question the capacity of students in this age group to succeed with this type of high-level and abstract reasoning. The nature of falsifiable statements and the analogy of Russel's teapot can be hard to grasp for both adults and academic scholars, not only due to its philosophical character, but also to the issue with distinguishing double negative statements from positive ones (which requires working memory resources). Counterfactual reasoning, a skill related to both cognitive flexibility, inhibition and working memory, is also still under development during childhood up to 12-14 years of age [40].

Question Q2, which addresses skepticism towards measles vaccine, stands out as the one with the lowest response rates, but with highest rates of appropriate answers. The students' answers state that one should try to talk to the sceptic in a reasonable way, trying to explain the benefits of taking the vaccine and why it might be dangerous not to take it. This questions also stands out as the one where the intervention has had the greatest impact, and students in the experimental group also often emphasize that one should address the sceptic in a calm and understanding manner (something that was discussed and enacted in the pedagogical follow-up). Likewise, the students suggest bringing up other medicines or similar situations trying to present new perspectives, e.g., that the sceptic probably takes aspirin when having a headache without knowing what substances are in these pills (something that was explicitly mentioned in the play). For the students, this question is perhaps more

concrete than the other questions with an answer that is easier to grasp and relate to than the other more broad and abstract questions.

Question Q4, regarding filter bubbles and the problems with TikTok deciding one's feed, was the most discussed one. This is not surprising, since this question was likely the most relatable one for the students. Most Swedish students in this age are familiar with TikTok, and the topic of fake news and social medias' filtering algorithms is not new to them but is frequently discussed both in school and at home. Hence, most students have already been in touch with this topic and therefore have something to write about and to discuss. Also here, however, students seem to confuse information literacy with source criticism (as for Q1), missing the underlying problem with filter bubbles. This specific topic is also (in line with Q3) slightly more cognitively demanding. Reflecting on one's own knowledge and information uptake requires metacognitive skills, capacities that are not fully developed until adulthood. Even if some declarative metamemory tasks can be handled surprisingly well by 12-year-olds (and even by younger children), other strategies are much harder to both understand and embrace [41]. To support a full understanding of the problem with filter bubbles for this age group, very concrete demonstrations and practical examples would probably be required.

A general observation is that many students emphasized that all people and voices must be accepted. They often put forth that all people should be allowed to share their meaning, for instance claiming that aliens exist. This relates to 'freedom of speech' and 'social equality', both being fundamental rights in all democratic societies. Nevertheless, there is also a challenge in this – from the perspective of democracy – as the 'false-balance' phenomenon illustrates. All information cannot be trusted and there is an increasing need to be aware of the information flooding through media, where in principle every person can reach a very large audience. With well-developed information literacy, one has the tools to decide when and why to be skeptical as well as what is motivated to be trusted.

In one sense, the 6th grade students seem relatively knowledgeable about the topics covered in the play and the pedagogical follow up. At the same time, however, their knowledge seems to be on a superficial level. On some questions they are stuck at the level of 'source criticism' and even though this is one important building block, it needs to be complemented with information literacy. During the discussions and in the free-text answers it also became evident that some students tend to address topics or problems quite literally, mainly reproducing memorized facts or statements and not reflecting on what these really signalize or what the consequences might be if these are dealt with in different ways. Such more high-level reflections are clearly not easy for all students.

As stated above, not all aspects of information literacy may be easy to grasp for 11 to 12-year-olds. Yet, postponing the subject until later grades in school might also involve risks. When children enter adolescence, they start creating strong identities and values, often positioning themselves as a part of a specific group or a trend. During this process, it might be even harder to separate facts from opinions, not at least due to the social and emotional costs that can be associated with believing in someone or taking someone's perspective [42]. Consequently, the subject as such should definitely not be avoided due to the participants' age; however, the topics and discussions need to be at an appropriate level.

Regarding the interventions, two questions (Q2 & Q3) stood out as more replied to in the experimental classes than in the control classes. In the play Q2 is addressed in a concrete and relatable way, and this is possibly why the experimental classes reason more easily and adequately. In Q3, the students in the experimental group more often mention that it is not up to them to prove someone wrong (even if the proportion of students making such statements is modest). This issue was quite tangibly discussed and visually demonstrated with a teapot in the play. Yet, the underlying meaning of

Russell's analogy might have benefitted from a more concrete example that the students could relate to at a personal level (such as, what happens if someone states that "you can't prove that you haven't done this or that"). The other two questions (Q1 & Q4) might be to abstract to grasp with this short intervention.

A tentative conclusion is that an intervention combining learning science and drama can be one way to concretize and contextualize at least some aspects of information literacy for the age group, although the need for concrete and easy-to-grasp narratives is essential. If engaging in this type of activities, it would probably also be beneficial to present several different problems on the same topic. A longer and more classic drama pedagogical intervention, where the students act and take opposite sides in a role-playing activity would probably also result in a more significant impact on the students' understanding.

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