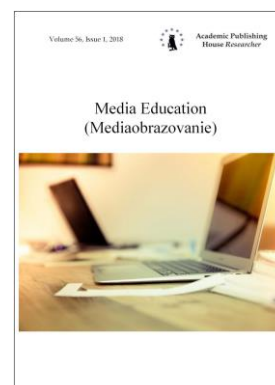




Published in the Slovak Republic  
Media Education (Mediaobrazovanie)  
Has been issued since 2005  
ISSN 1994-4160  
E-ISSN 2729-8132  
2020, 60(4): 636-644

DOI: 10.13187/me.2020.4.636  
[www.ejournal53.com](http://www.ejournal53.com)



## Media and Scientific Literacy Development within the Framework of Public Engagement with Science

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### Abstract

The article explores Ukrainian scientists' public engagement through popular science media, which they launch themselves, and which have become a component of the country's media environment. Today, unlike the long-standing tradition of avoiding contact with public, Ukrainian scientists especially of the younger generation have understood the importance of public engagement. Popular science media produced by scientists play a role of a communication platform that aims to unite science with a general audience.

According to the study results, there is no doubt about social significance of scientists-led media in Ukraine within a public demand for science-related content, wide spreading fake and pseudoscientific information, the insufficient development of science journalism, and current public invisibility of science. These media can help to disseminate scientific knowledge to the public, increase its critical thinking and comprehension of science-based content, promote scientific and media literacy.

However, the review of scientists-led media and the survey data from young media consumers have revealed that these media need improving to do their tasks. The findings have proved that the subsequent release of the popular science media produced by Ukrainian scientists should satisfy consumer requests and modern media trends.

**Keywords:** public engagement with science; scientific literacy; media literacy.

### 1. Introduction

Ukrainian scientists point out the lack of funding for research, extremely low salaries, and an inefficient system of science organization as the main causes of declining the science status in society, reduction of the prestige of scientists, and outflow of personnel. Nevertheless, considering society as a proponent of successful science and an ally for the pressure on the authorities, enthusiastic scientists have launched a previously unusual communication with the public. Thus, the crisis of science made scientists mobilize for public engagement, which "includes all forms of scientists' communication with non-scientific audiences" (Bauer, Jensen, 2011: 3). Today, active and indifferent Ukrainian scientists not only conduct online and offline scientific picnics, days of science, roundtables, exhibitions, workshops, project contests, public lectures etc. but also produce their own popular media.

In fact, the efforts to increase the prestige of science and scientists' social status are more likely to be supported by the public, if they also show the value of science and researches. Similarly, good proposals will be approved by the authorities if society is prepared to accept such investments as

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vital to the country. Hence, demonstration of the positive science impacts helps improve the image of science in the society, brings science closer to people, and supports the interest toward science.

Science engagement is relevant to the public too. This is, firstly, because of the growth of education level and the increase in the amount of information make citizens connected to science more. Secondly, the presence of the scientific segment in public discourse is important for overcoming the challenges that Ukraine is facing today, and for improving people's lives. Besides, people need reliable scientific information from reputable and trusted sources. In fact, most of them, unfortunately, do not distinguish between fake and other types of news (Levitskaya, Fedorov, 2020: 69). Today the ubiquitous distribution, universal accessibility and absolute freedom in posting any information in the Internet make specialists reflect on the development of knowledge and skills that contribute to the selection, use, critical analysis, assessment, creation and distribution of media texts, understanding media functioning in society, i.e. the media literacy (Fedorov, 2017: 19; Levitskaya, Seliverstova, 2020: 79). Actually, scientists as public communicators can effectively contribute to the dissemination of credible data on science issues and support the development of scientific and media literacy of an audience. Finally, Ukrainians are not sufficiently informed about science, the social demand for scientific content is not satisfied, and the niche market of popular science media is underdeveloped in the country (Petrushka, 2017). Therefore, the media is a convenient and accessible place for public engagement with science. Moreover, publicly communicating science is a major indicator of the development of democratic societies (Cassany et al., 2018: 9).

## 2. Materials and methods

There is no information on the effectiveness of popular Ukrainian scientists-led media whether they reach the audience, how they are used, and how they affect the consumers' scientific and media literacy. Therefore, the study is aimed at filling in this gap. For this purpose, the research was conducted by combining theoretical and empirical methods. Firstly, a self-completion questionnaire survey has been applied in the study. This method has been chosen because of its convenience for gathering information and determining audience's opinion on a particular issue or problem. Development of the survey included pre-testing (n=30) and pilot-testing (n=50).

Concerning the sample, young people were chosen for the survey. This was due to the fact that the media explored in this paper identify the youth as their target audience. Additionally, studying the youth allows revealing the prospects for the development of any processes and phenomena, including media issues. Therefore, the youth tends to gain substantial attention in scholarly research. Precisely put, I opted to concentrate on the most active part of young people who are university students. Participants were surveyed by using a random sampling method. I chose this dissemination route to reach a large number of people with a general interest in science issues. Although the online survey is a cost- and time-effective tool for garnering a large sample size, it has not been applied because the online and social media nature of its distribution introduces a self-selection bias (Bethlehem, 2010: 161; Finkler, León, 2019), whereby the sample may not be representative. In total, the sample includes 400 students of the same age category (18 to 25) from the university I am working at. The survey lasted during October 2019 – February 2020.

Respondents' answers are an empirical basis for finding out major tendencies related to stated subject as they provide context for the qualitative analysis. Besides, the following methods were used as a review of scientists-led media and literature, selection and discussion of theoretical material, comparative method, combined qualitative and quantitative data, and analysis.

Research materials are the academic articles and books concerning the paper theme as well as popular science media produced by Ukrainian scientists.

## 3. Discussion

Scholars highlight the diversity of connections between science and society (Jünger, Fähnrich, 2020: 387). Generally, people do not turn to science in debates about scientific findings. Instead, people use science to make everyday decisions and get answers to personally relevant questions (König, Jucks, 2019: 401-402). As Weigold states, effective communication would help non-scientists become more literate about what scientists know, and most people encounter scientific information only from media coverage (Weigold, 2001: 173). Certainly, mass media provide an audience with data on science. According to Armon, the media form major sources of

information to the general public in matters of science (Armon, 2016: 3). Furthermore, the transmission of quality scientific information is crucial, and demand for this kind of information from citizens is growing (Cassany et al., 2018: 9).

However, traditional journalism has recently experienced a collapse, and science journalism has become a main casualty. Considering media covering science in Ukraine, it is fair to say that science journalism is underdeveloped and the popular science segment in country's mass media is very little. Ukrainian scholars (National..., 2018; Petrushka, 2017: 185) emphasize the necessity to improve media reportage of science issues.

In this context, David and colleagues state that one potential remedy is to encourage scientists to write for news media about science. The authors assert that scientists as science reporters can fill the science journalism void (David et al., 2020). Therefore, in the current media environment, academics often communicate on science directly with laypeople via the Internet rather than rely on journalist gatekeepers (Lee et al., 2018: 274).

In Ukraine, launching popular science media by scientists themselves indicates that Ukrainian academia also aims to cover science issues in mass media and directly disseminate scientific information, bypassing journalists. This demonstrates the emergence of scientists' media activity, which is a new phenomenon in the country's media space. Thus, more information on science is appearing and it is becoming more diverse. Moller Hartley says that scientists and journalists take different positions according to the existing ideals within their respective fields (Moller Hartley, 2017: 211). Likewise, Armon notes that journalists and experts differ in what they consider as newsworthy and relevant (Armon, 2016: 3). As a result, the single viewpoint of the "matrix" type disappeared (Pocheptsov, 2019). Today, the amount of content about science created by scientists as direct newsmakers outside the traditional media is considerable. Examples of modern scientists' media projects prove that journalists as an intermediate can be excluded from the communication chain. Therefore, it may be assumed that, on the one hand, science communication would be possible without journalists and, on the other, without traditional media but only through the Internet.

Indeed, the Internet and new media give modern scholars space and possibility for communicating science. Nonetheless, with the benefits of the Internet, users face threats and harm, too. For example, Molek-Kozakowska reveals that science communication in online media is turned into infotainment (Molek-Kozakowska, 2017: 69). Lee warns that the Internet poses a variety of risks including scams and the spread of misinformation (Lee, 2018: 460). Others maintain that digital media, while opening a vast array of avenues for lay audience to engage with science, have become a fertile land to spread misinformation and disinformation, stimulate uncivil discussions and engender ill-informed, dangerous public decisions (Nguyen, Catalan-Matamoros, 2020: 323).

Furthermore, Kizer suggests that in an age of media oversaturation, it has been increasingly easier for pseudoscientific information to be disseminated among the masses. Science is not always well understood by the public, either as a specific process or a general concept. As a result, science is vulnerable to abuse and distortion (Kizer, 2018). Researchers show that when general-interest media address the topic of pseudoscience, they do so especially through pieces of news (Sanchez-Hernandez, Marin, 2019: 117). Unfortunately, for ordinary people, false science news often does not differ from legal science. For example, 65 % of Ukrainians do not distinguish fakes from truthful information, and their number has increased (Pylyp..., 2019). Arguably, an onslaught of fake science news can weaken trust in science, cripple decision-making processes and threaten the legitimacy of science (Ho et al., 2020).

Lee believes that one important strategy for combating such threats is through media literacy education (Lee, 2018: 460). When news consumers are literate, this means that they understand how information is produced, consumed, and how personal biases and existing beliefs may play a role in how news is interpreted (Hameleers, 2020). Others argue that enhancing scientific literacy and news literacy, especially equipping with the tools to identify, consume and share high-quality information, is a foundational stone to combat mis/disinformation (Vraga et al., 2020). Scientific literacy referred to non-scientists' need to understand science and its role in people's professional, social, and personal lives. As Durant emphasizes, scientific literacy should not be taken to mean the knowledge of a lot of science, but rather the understanding of how science really works (Durant, 1994: 83). Scientific literacy involves not only comprehension of basic concepts, but also it requires the importance of understanding "falsifiability" of scientific data (Zen, 1990: 463). Scientific

literacy is of great value as it gives a context for solving social issues and helps science-literate citizens successfully overcome a lot of problems having reached prudent and informed solutions that can improve live quality. Moreover, a robust democracy depends on a well-educated citizenry (Ashley et al., 2017: 91).

Scholars propose to support scientists' interventions against fake science news and encourage scientists to raise people's science news literacy. These can be done by bringing to the scientists' attention their contributions to public welfare and sense of duty that they already possess in providing accurate information on science (Ho et al., 2020). Noteworthy is the opinion that exposure to elite discourse about fake news leads to lower levels of trust in media and less accurate identification of real news, and may prompt the dissemination of false information (VanDuyn, Collier, 2019: 29). Even though a fake can be trustfully regarded as genuine not only by the general audience, but also by scientists who have not questioned the source and accuracy of information, representatives of the scientific world are considered to be the most informed community (Fedorov, Levitskaya, 2020: 241–242).

Besides, spreading awareness about science faces progressively larger communication challenges due to the complexity, innovation pace, and broad applicability of these innovations (Mueller-Herbst, 2020). These challenges as well as public require for science-related content, as poor development of science journalism, and the consequences of fake science news make creation of a high-quality media product on science issues obvious and pertinent. Thus, to mitigate the impacts of potentially dangerous dis/misinformation and to obtain scientifically correct data, public can, if to rely on the criteria of credibility, mainly on information from reliable, reputable, scientific resources. As such, scientist-led media can be an effective tool for spreading information and issue guidance. Scientists as an authoritative source of scientific content can better than anyone else combat false science, encourage critical thinking and critical perception of science-related content, and grant people qualitative scientific information.

However, a great number of Ukrainian researchers do not know that one of the key tasks of modern scientists is to inform about science and their scientific activity (Gutov, 2016). According to the poll, 55 % of Ukrainian scientists state that it is difficult to convey information on science issues by the media, and the more experience of scientific work was, the more often the respondents mentioned the problem of informing a wide audience about science (Rating, 2017: 3).

Nonetheless, there is social demand for scientific information, so it should be met by popular scientific content in the media (National..., 2018). In response, Ukrainian scholarly community, especially young scientists, has recently been thinking about the need for public communication. For example, Senenko advises fellow academics to talk more about their work to people (Senenko, 2018: 57). Sholukho notices that the scientists' presence in the media contributes to improving the quality of information and related scientific and media literacy of the population, puts obstacles for numerous amateurs, as well as fakes and other harmful media products (Sholukho, 2015: 226). Additionally, the researchers' interest in science communication is also justified by the mentioned above poll (Rating, 2017: 7), according to which 86 % of Ukrainian scientists admit the necessity of their participation in public engagement.

Furthermore, in the public's view, science is important: most Ukrainians consider it an integral component of the country's development (Vernadsky..., 2019: 55). The media, including those produced by scientists, aim to play a role in shaping such opinion. Scientist-led media have at least three particular functions: first, they are a segment of public engagement designed specifically for the treatment of science-related issues first-hand, i.e. directly from academia; second, they disseminate scientific content and increase people literacy; and third, these media enhance the social capital of science and influence the image of science in society.

In other words, scientists are starting to get out of the cocoon and trying to reach the lay audience (Zivkovic, 2010). Launching own media confirms scientists' effort to contact with a wide audience, make science more open, and thus support citizens' scientific and media literacy.

#### 4. Results

Explored main features of Ukrainian popular media produced by scientists have revealed that they are either outlets of scientific institutions, including the National Academy of Sciences of Ukraine (NASU) – the country's main basic research organization, or voluntary non-profit projects by scientists-enthusiasts. Most of these media are multi-thematic and function online, and the two print magazines have web counterparts (Table 1).

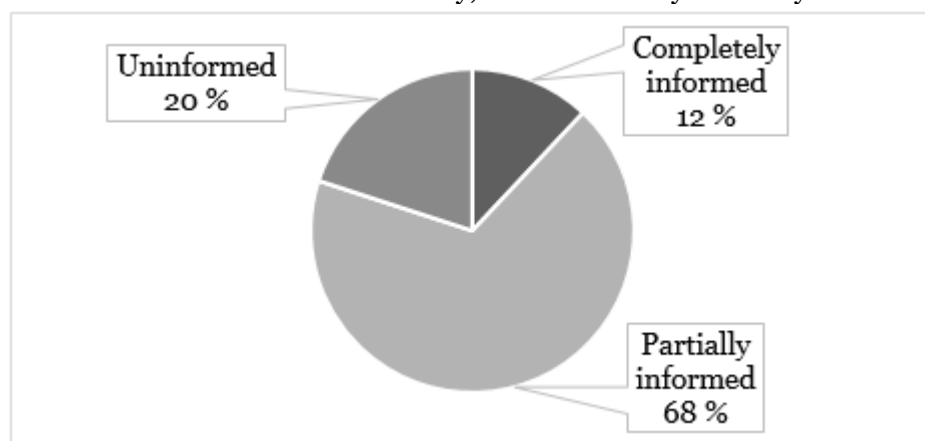


**Table 1.** Popular science media produced by scientists in Ukraine

Title	Type	Topic	Who produces	Year of launching
Inventor and Rationalizer	Print magazine (quarterly)	Energy, ecology, environment	NASU	1998
Outlook	Print magazine (bimonthly)	Various fields of science	NASU Main Astronomical Observatory of Ukraine	2006
Expedition XXI	Online	Arctic and Antarctic studies	National Antarctic Science Centre	2018
My Science	Online	Biology, medicine, physics, geography, chemistry, astronomy	Initiative groups of scientists	2011
Pulsar Scientific	Online	Medicine, nature, technology	Initiative groups of scientists	2014
Microbe and Me	Online	Microbiology	Initiative groups of scientists	2018

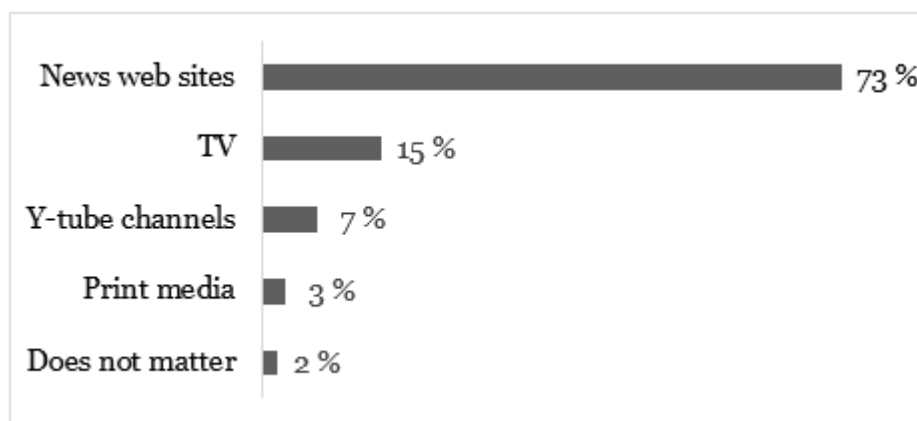
According to the survey, 12 % of respondents state they feel completely informed about science; 68 % – partially informed, and 20 % consider themselves to be uninformed (Figure 1). Simultaneously, almost all of them answered positively when asked if they would like to get further information about science.

As results show, youth is not informed enough about scientific issues. Popular science media are intended to reach a wide audience and meet the consumers' informational and cognitive needs. However, the potential audience is not currently provided fully with scientific content. Despite a social demand for popular scientific knowledge, the media including scientists-led media reach a small segment of public. The lack of the youth access to scientific information poses great threats, since it shortens the level of scientific literacy, limits the ability of society to develop and reach progress.



**Fig. 1.** Percentage of interviewees who answered the question whether they feel informed about science-related issues

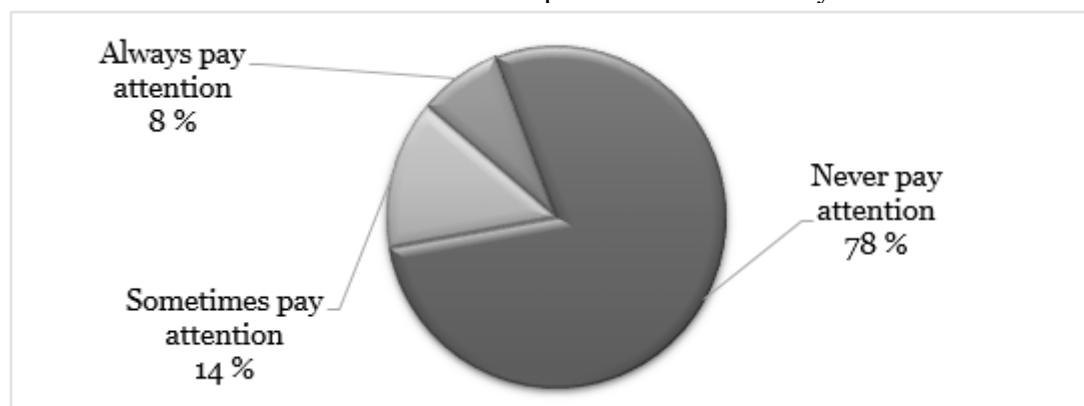
The most popular source of science-related content for Ukrainian students is news web sites (73 %). The sources follow them, but by a significant margin, are TV (15 %), u-tube channels (7 %), and print media (3 %). Hence, according to the respondents' answers, internet-based media are the youth's preferred sources to receive information on science (Figure 2). This reflects the global trend in the growth of web consumption. Undoubtedly, the Internet influences public engagement with science and empowers the public to be informed. As the Welcome Global Monitor finds, "access to the Internet appears to be an important factor enabling a person to seek information on science" (Gallup, 2019).



**Fig. 2.** Percentage of respondents who answered the question what type of the media they prefer for receiving scientific content

Noticeably, the respondents are more willing to use general online sources rather than specialized ones. The survey data have shown that scientist-led media are not very popular – only 12 % of the respondents indicated them as priorities. Additionally, these media are not well known. Although most young people (79 %) are aware of one or two popular science media from the listed ones, far fewer (42 %) know about three of them, and so, in the decreasing order, to only 11 % of the respondents are aware of all ones. Moreover, 21 % of the survey participants do not know any of scientist-led media.

Another important aspect in the study is who can better communicate science – journalists or scientists. Almost unanimously, participants believe that the materials of both of them can be of high quality. Additionally, 78 % of surveyed never pay attention to media content authorship, 14 % – sometimes, and only 8 % always find out who is the author (Figure 3). Therefore, corresponding to the survey, the status of both academics and journalists is equally important for the audience, and the information from both sources is perceived comfortably.



**Fig. 3.** Percentage of people who answered the question whether they pay attention to authorship of science-oriented media texts

Instead, the quality of the material is more important for the survey participants, but not the authorship. Although researchers indicate that information seekers are sensitive to how scientific information is presented and who presents it (König, Jucks, 2019: 413), the survey of Ukrainian youth shows the audience's attention to the quality of the information and the indifference to its authorship. The obtained data have manifested that the desired features of media coverage are simplicity and accessibility (97 %), interesting content (96 %), visualization (91 %). Besides, respondents pay attention to credibility (89 %), interactivity (81 %), relevant headings (26 %), hypertextuality (20 %), and number of categories (4 %).

According to the survey, media consumers prefer clear, understandable and interesting information. It proves that such content can better attract youth to serious topics. Therefore, scientists need to adapt their media texts to common people in order to be understood. Besides, the study shows that visual material is equivalent to the text for media consumers. It indicates that the text itself cannot attract and retain the attention of a demanding youth. These results prove that

images have become an important tool for communicating science. Additionally, this is due to peculiarities of perception: the text enriched with the image and/or video increases the reader's attention. Hence, it is good to add images, infographics, maps, video, etc. to the media produced by scientists.

Based on the respondents' answers, it is worth mentioning that the credibility of scientific content is valuable for young people. This indicates the audience's willing to have credible and reliable science-oriented content, no fake news. Additionally, according to the survey, interactive services are also important to the youth. This confirms that nowadays, interactivity is an organic feature of new media, on the one hand, and of modern youth, on the other. In this regard, the scientist-led media presence on social networks is a good way to strengthen the online presence of science outside of academia.

However, the review of these media reveals that online outlets do not fully utilize modern digitalization; for instance, the share of illustrations and photos is negligible. The most common format of multimedia is static illustration and its variants (individual photos, drawings, and infographics). Video content is presented the least. This is most likely due to the fact that producing original videos is much more complicated and costly than photo or text publications. As for print media, text also prevails over non-textual components. Besides, scientists-led media are not sufficiently represented on the social media platform so far. Such not fully usage of print and the Internet capabilities leads to a depletion of the design and content of the media and diminishing of their attractiveness. This situation can be explained primarily by the lack of resources, both human and financial. Firstly, three of the scientists-led media function as volunteer projects, provide their content for free and do not advertise. As a result, scientists work on the enthusiasm or conduct media business by means of charitable and contributions, sponsor support, etc. that are unsystematic and insufficient. Secondly, those media, produced by scientific institutions, are also limited in resources because of the meager funding science as a whole.

Consequently, the research results show that media consumers want to have scientific content, but a lot of them feel uninformed and dissatisfied with the media coverage of science. According to the findings, it is clear that scientists-led media need improvement. Otherwise, their current level threatens that these media will continue to be ineffective.

## 5. Conclusion

Today, the awareness of the importance of popular science media as a channel for science-based content disseminating and a way of public engagement with science is growing in the Ukrainian scientific community. Scholars through own popular media can reach a broad and diverse audience as well as have opportunities to provide public with the information on science issues and explain the impact of scientific developments on society. Most importantly, scientists as a reliable and authoritative source of scientific content can successfully prevent the false science and pseudo-science spread and "twisting" scientific knowledge, create a scientifically correct media product, promote the formation of critical thinking, media and scientific literacy among media consumers.

In this regard, the following outlined points suggested here are important aspects to consider for supporting media and scientific literacy development in the context of public engagement with science. Firstly, as the youth prefer electronic science-related content, the Internet is an effective means of improving the audience's literacy. This requires that scholars should use the possibilities of the Internet to communicate science to the fullest. Secondly, high-quality media content would stimulate people to enhance media and scientific literacy. That is why scientists should satisfy the audience's preferences and demands, especially since they conform to the laws of the information perception, on the one hand, and general media trends such as simplicity, availability, visualization, credibility, interactivity, on the other hand. Thirdly, to increase the quality of media coverage, science communication training should be implemented in Ukraine. Actually, communication still is not obligatory in the country's scientific system. In fact, scientists' communication activity is mainly based on their initiative and enthusiasm. Nevertheless, the level of institutionalization of science communication influences the whole cycle of content production and dissemination. Therefore, in conjunction with the above, public engagement with science is challenge not only for scholars and academic institutions but also for authorities and society in general. State-level support and institutionalization of science communication in the Ukrainian

scientific system would help effectively engage with the public through the media and promote media and scientific literacy development.

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