



**SCIENCE JOURNALISM FOR DEVELOPMENT IN VIETNAM:
A MULTI-FACET INVESTIGATION OF ISSUES AND CHALLENGES
AND ITS IMPLICATIONS FOR THE GLOBAL SOUTH**

TRAN THI YEN MINH

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STATEMENT OF ORIGINALITY

I hereby declare that this thesis represents my own work, except as acknowledged in the text. It has not been submitted for the degree of PhD at Bournemouth University or any other institution.

The following publications have been revised, updated and incorporated in this thesis either as passages or as single chapters:

1. Nguyen, A. and Tran, M., 2019. Science journalism for development in the Global South: A systematic review of its characteristics, issues and challenges. *In: Proceedings of the 69th Annual Conference of the International Communication Association, Washington, DC, 24-28 May, 2019.*
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Candidate's Signature



Tran Thi Yen Minh

Principal Supervisor's Signature

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4. Tran, M. and Nguyen, A., 2019. Professional challenges and impediments to science journalism in Vietnam. *In: IAMCR Communication, Technology and Human Dignity: Disputed Rights, Contested Truths*, Madrid, 7-11 July 2010.
5. Tran, M., Nguyen, A. and Thorsen, E., 2019. The representation of artificial intelligence in Vietnam news media: Attention, sources, frames and attitudes. *In: Future of Journalism 2019*, Cardiff, 12-13 September 2019.
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ABSTRACT

Context: Although science journalism plays a central role for development in the Global South, it has not reached a high level of professionalism. However, the literature on science journalism in developing countries is still thin. The majority of existing studies have used science journalism in developed countries as a benchmark to evaluate that in the developing world and to propose reporting practices that might not be entirely relevant to the latter. Furthermore, an overwhelming amount of research employs content analysis to explore the tip of the iceberg, but less attention is paid to the complexity in the process of news production, including news sources, media ownership and control, journalistic ethics and strategy, political implication and interest groups' influence. The lack of in-depth analysis shows a gap in understanding the nuance of science reporting in the developing world.

Aims: This study uses Vietnam as a research site to gain empirical insights into the current status of science journalism professionalism in a developing. First, it aims to uncover how Vietnamese science journalists perceive their professional roles in relation to Vietnam's development processes and the key obstacles and challenges to their ability to perform such roles and to achieve professionalism. Second, the work investigates news representation of two scientific controversies, artificial intelligence and genetically modified organism, to examine the content practice of Vietnamese science journalism and its implications for the country's national development. Placing the findings in the context of other developing countries, it assesses the implications of weaknesses in the Global South's science journalism for global science debates and international development efforts.

Methods: A mixed-method approach was employed. In the first phase of our study, semi-structured interview with 26 science and reporters was used to examine the local journalists' perception and practice, addressing how Vietnamese journalists perceive and perform their roles. Particularly, the thesis attempted to detail the processes of their news gathering, sourcing and framing, representing science events and issues as well as their attitude towards the science reality in Vietnam. From this, the second phase of the study employed a mixture of content analysis and

interview data to investigate how such journalistic role perceptions and performances are reflected in science news output, through the case of global science controversies. Thematic content analysis was employed to elucidate how the beliefs, attitudes, knowledge and practices of Vietnamese science journalists manifest in their science news output. By analysing the presence, meanings and relationships among patterns of science news stories, the study would capture the writers' perception and behaviours and provide insights into how the newsroom frame and shape public understanding of science. The characteristics of science news found in the content analysis were then linked to interviewed science journalists' professional attitudes and capabilities to explore potential causal relationships in science journalism in Vietnam.

Findings: Data from in-depth interviews show that despite their high expectation for science journalism, the media fail to promote public understanding of and engagement in science. Vietnamese journalists lack the essential professional knowledge and skills to deal with science events and issues. Having reported science for some time, several still struggle to define what science journalism is or should be about. They generally disregard the local relevance and importance of controversial science developments, and when they pay attention, they rely heavily on foreign sources and are uncritically skewed toward benefits at the expense of proper reporting of risks, including risks that are highlighted in the country's development. Also, with less than enthusiastic support from science-unfriendly news editors and executives and with a rampancy of unethical practice, they tend to sensationalise science to attract the audience, sometimes with some disastrous consequences. Added to these are a number of challenges and obstacles from outside the newsroom, including insufficient and reluctant cooperation of local scientists, political control on science and policy reporting, and commercial influences.

Further analysis into how their perceptions and performances are reflected in media coverage of genetically modified organism (GMO) and artificial intelligence (AI) shows that Vietnamese science news fails the job of engaging the public with controversial science developments that bear implications for their national development. During the two-year examination, Vietnamese newspapers do cover GMO and AI, but are predominantly event-driven with inadequate focus on their

controversial aspects. There is a lack of critical reporting to inform and engage the public in the debate over GMO and AI's potential adverse implications as the media give more preference to discussion over GMO and AI economic prospects and scientific progress. Accordingly, news coverage of both issues is associated with more benefits to risks. Despite these similarities, news coverage of GMO is dominated by foreign source whereas local journalists publish more domestic stories about AI. However, few international stories are localised into indigenous context, making GMO and AI less relevant to Vietnamese public daily concern.

Conclusions: Combining the data from in-depth interview and content analysis, the thesis argues that similar to other developing countries, science journalism in Vietnam is far from achieving a necessary level professionalism for developmental causes. Thus, it is in need for more appreciation by all stakeholders, especially news executives and the science establishment, of the importance of science journalism for development. Further, placing the data in the context of Global South, the thesis calls for more serious investment in capacity building, especially through training and mentoring, for science journalists in the South to fulfil their mission for national development.

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Chapter 1

SCIENCE JOURNALISM FOR DEVELOPMENT IN THE GLOBAL SOUTH: VIETNAM AS A RESEARCH SITE

Science and technology (S&T) pervades in almost every aspect of our lives. It is seen as an engine for increasing human living standards and improving sustainable development. For developing countries, S&T plays a central role in helping them to reach the United Nations' millennium development goals (Parliament Office of Science and Technology 2004, ESCAP - United Nations 2017). While bringing exceptional benefits to socio-economic development, however, S&T carries uncertainties with potential risks to humans. Particularly when developing countries mostly adopt existing technological innovations from scientifically advanced countries, they are more vulnerable to science's potential risks. Thus, it is vital for them to be critically informed and well-prepared before engaging in and making any decisions towards controversial science-related issues. However, global science controversies, i.e. the disagreements between scientific claims and social beliefs, values and interests, which often cause and the public's uncertainty about science and its implications (Brante and Elizinga 1990, National Academy of Sciences 2017) are infrequently discussed in the non-industrial countries' public sphere. These issues are often a weak area of media coverage (Nguyen and Tran 2019). Like its counterpart in developing countries, Vietnamese science journalism does not seem to have a strong record. Anecdotal evidence shows that local journalists appreciate the role of science journalism but lack professional knowledge and practical skills in dealing with science, especially controversial science and technology issues. Yet, there is little systematic investigation into the current state of science journalism in Vietnam and how it contributes to national and global development. Nguyen (2014) is the only study into the current status of science in Vietnamese media, and even this publication has been restricted to certain circles of the World Federation of Science Journalists.

The noticeable gap in research of science journalism in Vietnam is in line with the present literature of such topic in developing countries generally. The history of scholarly research into science journalism has seen a consistent dominance by

Western perspectives. The lack of viewpoints from developing countries results in inadequate understanding of how global science issues travel across borders through media, and how science journalism contributes to national and global developments. Furthermore, an overwhelming amount of research employs content analysis to explore the tip of the iceberg, but less attention is paid to the complexity in the process of news production, including news sources, media ownership and control, journalistic ethics and strategy, political implication and interest groups' influence. The lack of in-depth analysis shows a gap in understanding the nuance of science reporting. This project hopes to address this gap, using the current status of Vietnamese journalism about science, especially global science controversies, as a case study with implications for development in the Global South. This first chapter will establish the rationale for this work and provide an overview of the work.

1.1. Science and technology for development

Science and technology (S&T) has played a vital role for *development* since the concept was proposed by US President Harry Truman to replace the notion of *civilisation* as the dominant discourse for the Western influence on other parts of the world. With the division of the globe into the developed and underdeveloped worlds, Truman generated a new pragmatic vision of development in which distance would be optimistically diminished by the effective transfer of science and technology from the more to the less developed countries:

“With the cooperation of business, private capital, agriculture, and labour in this country, this program can greatly increase the industrial activity in other nations and can raise substantially their standards of living. Such new economic developments must be devised and controlled to the benefit of the peoples of the areas in which they are established. Guarantees to the investor must be balanced by guarantees in the interest of the people whose resources and whose labor go into these developments. The old imperialism--exploitation for foreign profit--has no place in our plans. What we envisage is a program of development based on the concepts of democratic fair-dealing. All countries, including our own, will greatly benefit from a constructive program for the better use of the world's human and natural resources. Experience shows that our commerce with other countries expands as they

progress industrially and economically. Greater production is the key to prosperity and peace. And the key to greater production is a wider and more vigorous application of modern scientific and technical knowledge.” (Truman 1949)

Despite criticisms of it imposing an American post-colonial ideology on the rest of the world, Truman’s notion shed a light on the role of S&T for economic development and human living standard improvement. Contemporary policy makers continue to see S&T as a “powerful means for solving many of the challenges facing humanity” (Annan 2003). The outcomes of science – from universal vaccination, green energy and genetically modified crops to affordable digital technologies and the like – have become an engine for economic growth, climate change mitigation and adaptation, hunger eradication, poverty alleviation, health enhancement, education improvement, personal freedom and social progress. For example, the advancements in genetically modified crops and seeds are believed to have eliminated poverty and hunger and further improved the nutritional quality of food in South Africa and Asia (Naicker 2015). Recent applications of artificial intelligence to healthcare, education and agriculture are expected to enhance the national competitiveness (ESCAP - United Nations 2017). Research show that countries which have S&T innovation orientation tend to achieve stronger global competitiveness and sustainable growth (Şener and Saridoğan 2011). The globalisation of S&T is the key to global efforts towards the United Nations’ previous Millennium Development Goals and current Sustainable Development Goals (Parliament Office of Science and Technology 2004, Naicker 2015, ESCAP - United Nations 2017). S&T policies are designed to help many countries in developing world practically address the long-term developmental issues to build a diversified, sustainable and competitive economy that guarantees a high quality of life for human beings, and as a result, to raise public engagement in democratic process. Vigorous and effective, but vigilant adoption of S&T invention and innovation from the North to the South, thus, lays at the heart of global policies and concerns.

1.2. Science journalism for development

While its contribution to development is indispensable, scientific knowledge will not act alone as a primary determinant of development unless it effectively reaches

those who can benefit from and have power and skills to put it into practice. In that context, the news media, as the most effective channel in shaping public understanding of science (Nelkin 1995), play an essential role in preparing peoples and nations across the globe to choose and progress with the right S&T ideas and approaches. As a ubiquitous source of information, news media historically have a wider reachability to a larger number of individuals than other specialty science communication sources, such as science books, documentaries or museums. In the twenty-first century, even though citizens are inundated in the enormous amount of information from a variety forms of electronic channels, they continue depending on news media for independent, accurate, and in-depth science knowledge (Allan 2011, Dunwoody 2014). This is especially the case when science is involved in controversies, e.g. risk over genetically modified food, danger behind smiling humanoid robot Sophia or public health crisis such as Sars epidemic in 2002-2003, Ebola outbreak in 2013-2016 or the ongoing Covid-19 pandemic, where controversies bring not only physical damage but also crises of misinformation. The more scientific chaos “goes viral” on the social media, the more today’s citizens rely on the mainstream media for accountable and reliable science evidence. Good journalism, hence, serves as both scientific sources to enhance public knowledge over pervasive fear of science risks and an educator to provide public with guidance on the science advantages and impacts of science that help them to make rational choices towards scientific controversies. Without critical investigation beyond science stories and an expertise of digging into the aspects that are rarely publicised, journalism could oversimplify scientific fact and truth, and thus, distract and mitigate public engagement in science. This becomes significantly crucial in the climate of increased democratisation of the 21st century. While science is uncertain and embedded in society, there is a growing demand among lay public for active involvement in science policy and its applications (Secko et al. 2013). Professional science journalism, thanks to the distinct advantages of its multi-media capacity and its obligation to public engagement, can be seen as the most appropriate and promising platform for lay audience participating in the discussion over science uncertainty and its related policy issues. By organising and leading public fora over science and science-based development guidelines and policies, science journalism would make considerable effort to have a diversity of viewpoints, especially from the

less-developed parts of the world to the global S&T management, transfer and adoption for achieving the sustainable development.

Thus, a strong base of professional science journalism is of significant importance to the world's successful transition towards a more sustainable and prosperous future. While it is impossible for journalism solely undertake all science communication missions (which would be solved in tandem with direct, personalised communication modes), few other science channels would be able to match its still widespread reach and influence, at least at the level of gate-keeping, agenda-setting and debate-framing. Whichever science journalism model is implemented – whether it is to provide information about new scientific discoveries, to address and analyse science risks and benefits, or to lead society in science debates – science journalism plays a vital force in influencing public awareness and action towards the scientific achievements related to their daily lives and/or the prospect of their local, national or global communities. This contribution for developing countries (as defined by OECD that are characterised by insufficient industrialisation and low Human Development Indices, including low income, low life expectancy and low educational attainment), is further important because at least three reasons.

First, the contribution of journalism for S&T diffusion is particularly important because for most people in developing countries, science knowledge is merely obtained from the news media than their past education, personal experience or speciality sources. The journalism main task is therefore informing the public about science basics, monitoring and reporting the new S&T achievements and their implications. As the vital instrument to S&T popularisation, good science reporting seeks to fill audience perception and enhance their ability to understand science by providing both scientific facts and context (Nelkin 1995, Angler 2017).

Second, prioritisation of technological application as a key force for development is not always as efficient as expected (Lugo-Ocando and Nguyen 2017). It is thereby crucial for science journalism to help developing countries avoid adverse effects of the overreliance on S&T for all development issues, especially poverty elimination. The role of journalism as a watchdog is even more indispensable as modern science and technology, while bringing exceptional benefits to human development, uncertainties around their potential threats to established social norms and values

raise serious concerns about long-term consequences (Appleyard 1999). Genetic modification crops, artificial intelligence robots and software, medical treatment via genomics, nanotech-material and the like are transforming the way we work, live and identify ourselves in unprecedented directions that even citizens and policymakers of advanced, scientifically savvy societies, let alone those of less developed ones, find it hard to grasp, monitor and control. While developing countries are mostly science receivers than developers, they are easily affected by science-related risks. Therefore, it is more essential for them to be well-informed before making any choices towards science, especially the controversial issues.

Third, the international development discourse has flaws that science journalism in developing countries need to monitor. It is based on a rather innocent optimistic in the developed countries' sincerity and compassion in transferring S&T to the rest of the world. In accordance with sincere attempt to assist the developing world with modern S&T, there have also been programs of technology transferring and knowledge sharing for development that are oriented by political and commercial interests of the governments and multinational/transnational corporations of developed countries. Many poor countries in Asia and Africa, for example, have long been "the rubbish dump" for the North's electronic waste devices. If journalism could ensure its role of a critical observer and a sceptical gatekeeper on science issues and related policies, it would strengthen the South's resistance to potential threats of unsustainable development. An informed and critical science journalism would assist the South to absorb and adopt scientific and technical knowledge for their development efforts.

1.3. Our limited understanding of science journalism in the Global South

As the key player with efforts to inform and engage public in science communication, the professional practice of science journalism in the Global South is placed in the heart of national, regional and global development. However, there is inadequate understanding of its current status – particularly its strengths and weaknesses, opportunities and challenges and its potential impacts on public understanding of and engagement with S&T and related policies. Particularly, compared to the rising attention to science journalism, as profession and as news content, in the Western context over the past few decades, such practice in the South is rarely discussed in

the academia (Schafer 2010). In an exhaustive search for a systematic literature review, Nguyen and Tran (2020) found only 157 peer-reviewed publications about science journalism in the developing world from dozens of top English-language media and communication journals and books over an 18-year period. For example, the authors' manual search on the archive of the *Public Understanding of Science* between 2000 and 2017 resulted in only 24 papers that have science journalism in developing countries as the major subject or focus. This is out of a total of 1003 articles published by this premier journal during this period, representing a miniscule proportion of 0.02%. Such imbalances in research, as Schafer (2010) points out, are in direct conflict with the notion and nature of science as a global system, leaving a gap in our knowledge about how science journalism in the Global South converges with and/or diverges from each other in the age of globalisation. In 2013, the *Journal of Science Communication* published an editorial calling for more scholarly attention to voices and perspectives from the less known developing parts of the world (Massarani 2015).

Moreover, we found that *the increasing media interest is also quite geographically uneven*. During 2000 – 2017, Asia and Africa received much more scholarly attention than other continents. Within Asia, research tends to focus on science reporting in the two emerging countries of China and India, while others such as Southeast Asian countries are rarely examined. This is in line with Navarro et al. (2011) and Schafer (2010) who observe from other data that Southeast Asia is a site of less interest for science journalism scholars. Besides, there is a clear focus of research into science journalism on print science journalism, which the domination of newspaper as the site for research. Despite that broadcast media play an important role in delivering science news and information to audiences of low literacy in developing countries (Farr et al. 2006, Jurberg, Verjovsky, Machado, et al. 2009, Locksley 2009, Ramalho et al. 2012, Castelfranchi et al. 2013, Shrestha et al. 2014), only a few studies were focused on radio and TV science news. Likewise, the nascent form of online science reporting was rarely main subject of analysis.

Regarding the specific aspects of science journalism being studied, it was found in this systematic review that two-thirds of the publications focus on journalists and their work, especially production and representation practices, with the rest

spreading between the communication routines and practices of scientists and science institutions as news sources, public engagement with science news and others. There is a stronger focus on science news output than on the processes behind it. This is further reflected in the prevalence of content analysis in the reviewed studies. Meanwhile, research based on interview data – i.e. survey, in-depth interviews or focus groups were infrequently employed to discover the root of science reporting. This dearth of qualitative research into science journalism in developing countries, which has also been found in science news is collected, sourced and framed in the developing world is still a thin area of knowledge. This study will use Vietnam as a research site to address some of the research shortfalls mentioned above.

1.4. The rationale for this thesis and research questions

Like other counterparts in the developing world, Vietnam appreciates the decisive role of science in the national developmental goals. However, science and technology capacity in Vietnam is not as sufficient as it desires. In order to set its role for development, the Ministry of Science and Technology prioritises science communication as one of the cornerstone to raise public awareness of the S&T significance: *“To promote advocacy and communication activities in the society, especially in enterprises on guidelines, policies and laws on science and technology, on key dynamic roles of science and technology for the country's construction and development in order to enhance spirits of self-reliance, consensus and strong support of the whole political system for science and technology activities; create the atmosphere of competition and creative labour, carry out research and development of science and technology in production, business activities and all fields of social life; and enhance accountabilities of organisations and people working in science and technology field for the country's construction and defence”* (Ministry of Science and Technology 2012). Meanwhile, independent research from The Organisation for Economic Co-operation and Development places science communication at core of the science productivity in Vietnam (Zink 2009). As the most appropriate and influential means of science communication, Vietnamese journalism, therefore, becomes vital for preparing the state to well apply and manage the modern science and technology adopted from the more scientifically advanced countries. Along with

its substitute for science promotion, it is more important for journalism Vietnam to awaken the society's trance on the myth of S&T's significance for development. Without an effort to accommodate and alert both state and citizen to science advances and limitations, journalism would otherwise drive Vietnam S&T strategy into the landscape of utopian.

Yet there is minimal understanding of how science journalism is practising in Vietnam. Like other ASEAN countries, research into Vietnamese science journalism does not have a strong record either. There has been little investigation into the contemporary status, issues, challenges of and potential initiatives for Vietnamese journalism. What has been more or less studied is the Vietnamese media response to climate change (Pham 2007, Shanahan 2009a, Pham Thu 2011, Freeman 2017) and biotechnology (Karembu et al. 2009, Le and Navarro 2011). Additionally, literature has seen more research interest in the news coverage of science achievements, natural phenomena, and how science and technology may affect human lives. There are missing studies focusing on the “most-matter” – how the journalists perceive their missions and practice as well as the relationship between the media and involved groups in raising public understanding of science. Only several anecdotes evidence the local journalists' appreciation for science journalism. Yet, in contrast to their keen conscious of science journalism's missions and functions, literature shows journalists, most of time, lack professional knowledge and practical skills to accomplish their tasks.

This work, therefore, attempts to address these gaps. It departs from the starting point that although it would not alone solve all science communication issues, science journalism is of significant importance for public understanding of, engagement with and action towards science. Research provides much evidence of how news media, among a number of factors, effectively inform and broadly affect citizens and policymakers in science, technology and risk (Weingart et al. 2000). The media template for Dolly the sheep in the UK, for example, is an important indicator shaping public perception of cloning (Holliman 2004). In the digital era of the twenty-first century, despite the onslaught of social media, a majority of American, up to present, rely on general news outlets for science information (Funk et al. 2017). For lay people in developing countries, news media, maintain the almost exclusive role in

influencing their understanding of science and engaging them with science and its socio-cultural, economic and political implications even though the now ubiquitous presence of online information on the Internet has, to some extent, affected human choices and actions (Dutt and Garg 2000). However, as the above discussion suggests, there are missing studies reflecting the contemporary state of science journalism in the Global South and evaluating what journalism has done so far to enhance public knowledge and engagement with science process. Particularly, of the thin and geographically uneven body of research into science journalism in the South, most empirical studies have so far come from the emerging countries, such as China and India whereas throughout examinations on science journalism has been almost absent in the remaining (Nguyen and Tran 2019). Moreover, when science journalism is mentioned, research has primarily grounded in the Western standard to discuss the practice of science reporting in the Global South (Veneu et al. 2008, Schafer 2010, Appiah et al. 2015). It is more complex as the South is mostly informed about others by the West because their intra-connection is not as vibrant and intensive as the inter-transmission between developed and less-developed countries (Pludowski et al. 2006). The superiority of the more-advanced countries to the less-advanced countries raises a question regarding how international issues are (mis)represented across borders through the news media. Yet without understanding the local socio-political structures, values and norms, there are no reliable means to access the practice of science communication in the developing world. This thesis thereby attempts to take a non-Western perspective to approach science journalism in the South. It uses Vietnamese media as a research site to look deeply into science journalism in the context of a particular developing country. Placing Vietnam news media in context of the Global South, this thesis explores the professional state, issues, challenges of science journalism in Vietnam, and its implications for national and global development. It is intended to be a considerable attempt to address the need for more research exploring the current state of science journalism in the developing world.

The thesis is theoretically underpinned by the concept that journalism is not simply “a product but a process of communication” which its social role is to inform public about the social reality (Harcup 2009). According to McNair (2005), journalism is a description of the existing world reflected by the journalists, following the required

journalistic norms and values through which it will be diffused to the public. In short, journalism can be defined as “the activity of gathering, assessing, creating, and presenting news and information”, but at the same time it is also “the product of these activities” (American Press Institute 2020). Having said this, science journalism is a result of science knowledge mediation, a production of social construction, involving the selection and construction of science “within particular circumstances and for specific reasons” (Holliman 2004). Holliman (2004) argued that process through which knowledge from science laboratory is transmitted to newsroom is generated and influenced by several factors. Thus, in order to have an appropriate understanding of science journalism, it is necessary to have an interconnected knowledge about both science news and its undermining complicated process. Following this point of view, this thesis will investigate the professional role performance of science journalists, particularly when it comes to reporting global science controversies. It also seeks to explore how economic conditions, social infrastructures and cultural circumstances might influence science reporting. Further to this and drawing on result derived from the analysis of science journalist’s profession and the factors challenging the production of science news stories, particular attention will be given to the media content, investigating how such issues and challenges reflected in the media coverage of artificial intelligence and genetic modified organism.

To be more specific, from the production-centric perspective, science reporting reflects the process in which raw science facts are conveyed from the laboratory to the public by science reporters. Although the course involves interactions among multi-stakeholders, and is governed by the newsroom norms and constraints, science journalists play the most vital role to interpret and transform the very detailed, specific, and often jargon information produced by scientists into a form that non-scientists can understand and appreciate. As previously discussed, of the sparse research into science journalism, there are few efforts excavating the root beyond the content that how Vietnamese science reporters perceive the roles and functions of science journalism, how they frame science and how they assess their own current professionalism level. In order to fulfil the lacked understanding of the current state of science journalism in Vietnam, the thesis raises the first research question by asking:

RQ1: How do Vietnamese science journalists perceive their professional roles in Vietnam's development processes?

- ***RQ1a: How Vietnamese science journalists perceive the professional role and function of science journalism?***
- ***RQ1b: How Vietnamese science journalists assess the quality of science journalism in Vietnam?***

As argued above, there are several implications affecting the process of science news production. Of the thin research into science journalism in the Global South in general and Vietnam in particular, there is evidence that along with the efforts of improving its professionalism, science journalism manifests in its reporting a wide range of problems. Thus, a stronger focus on how reporters are dealing with science, what issues and obstacles they are facing beyond science reporting is therefore much needed for science journalism studies. While only a few studies have taken this approach (Schafer 2010, Xu et al. 2015, Nguyen and Tran 2019), none was conducted in the specific context of Vietnam. This work, therefore, is intended to address the demand for a more throughout understanding of the current state of science journalism in Vietnam. In other words, in anatomising the causes of the (un)professionalism, it is worth looking at the obstacles inside and outside the newsrooms challenging Vietnamese science reporters to do their critical role for development. This thesis, thus, sets out to raise the second question:

RQ2: What are the key challenges to professional science journalism in Vietnam?

- ***RQ2a: What are the internal challenges to professional science journalism in Vietnam?***
- ***RQ2b: What are the external challenges to professional science journalism in Vietnam?***

From the content-centric perspective, science journalism is largely about science presentation. Thus, to have an intensive understanding of the Vietnamese professional science journalism, it is essential to explore how science messages are depicted in the news media. The literature shows a substantial body of research

exploring how climate change and biotechnology are represented in Vietnam newspapers. However, most of these studies so far have treated these issues as a single phenomenon rather than a form of science, especially a controversial matter. In this study, genetically modified organism and artificial intelligence are seen as representatives of scientific controversies. The two case studies were analysed in connection with each other, under the conceptual framework of scientific controversy. These examples are chosen due to their extraordinary and far-reaching implications for all human beings. They demand a broader understanding and greater interconnected engagement between publics and nations around the globe. In this context, an effective translation and explanation of science controversies by media across the world is thereby essential to ensure science is truly a global matter and all countries, rich and poor, more and less scientifically advanced, are included in collaborative research and technology cooperation. Especially, an informed, critical and engaged science journalism plays a crucial role in preparing publics and policymakers in the less developed part of the world to cope with and voice their perspectives over science controversies. Unfortunately, the last couple of decades have shown limited academic interest in the news coverage of global science controversies in developing countries. Particularly, research has seen its failure in reflecting media attention to several emergent issues, e.g., human cloning and artificial intelligence, directly affecting human beings, as well as challenging public understanding and their decision-making ability to lead their lives in a democratic society (Zhang et al. 2014; Ren et al. 2014; Billett 2010; Ramalho et al. 2012; Castelfranchi et al. 2013; Mercado 2012; Massarani et al. 2005; Massarani and Buys 2007; Carvalho and Pereira 2008). What has been more substantially studied is the media coverage of single science controversy, such as climate change and GM foods and crops rather than multiple issues connectively. Furthermore, scholars tend to employ content analysis to explore the tip of the iceberg, but less attention is paid to the complexity in the process of news production, including news source, media ownership and control, political implications and journalistic ethics and strategies. The lack of in-depth analysis proposes a gap in understanding the underlying principles of media report of global science controversies. This project hopes to address these gaps, using Vietnamese media representation of global science controversies as a case to investigate how science portrayed in the news and why it matters:

RQ3: How are global scientific controversies represented in Vietnamese news media?

- ***RQ3a: How are the socio-economic and ethical risks and benefits of Genetically Modified Organism represented in Vietnamese news media?***
- ***RQ3b: How are the socio-economic and ethical risks and benefits of Artificial Intelligence represented in Vietnamese news media?***

1.5. A mixed-method approach

In order to explore the above issues, the thesis integrates theoretical perspectives from several distinctive areas, especially science journalism, science and technology studies, and development communication. By exploring the case of Vietnam, the study seeks to gain insights into the common issues and challenges that science journalism in Vietnam faces, and whether these share the characteristics of science journalism in other developing countries. In order to achieve these objectives, a mixed-method approach was employed. The use of mixed-method is to address the key research issues: the perception of science journalists, their attitudes towards science, their journalistic practice, the operational framework of science newsrooms, the influential elements to science reporting, and also, their science news output as the outcome of the entire process.

Mixed-methods research, i.e. combining empirical findings from different data collection and analysis approaches, is considered the third major methodological paradigm in social sciences (Johnson et al. 2007). The method was first introduced in 1959 by Campbell and Fiske, with the argument that the combination of findings from multiple methods would magnify and validate research results which is hardly obtained from a single one (Johnson et al. 2007). Thanks to the advances of the two original methods, mixing approach offers more informative, comprehensive, balanced and reliable research outcomes. This study follows the traditional approach to mixing methods, known as Convergence Triangulation Design (Creswell and Clark 2011). This is a research design “to obtain different but complementary data on the same topic” (Morse 1991, p.122, quoted in Creswell and Clark 2011). In this model,

quantitative and qualitative data about a single issue are collected and analysed independently. The different results gained from separate data collection approaches are then used to compare, confirm and collaborate each other during the interpretation.

The reason for using this research design in this study is to allow qualitative and quantitative methods to complete the multi-tasks on their own, providing a credible and sustainable conclusion about the current state of science reporting in Vietnam. On the one hand, it purposely compares the qualitative findings obtained in-depth interviews with 26 science journalists in Vietnam with quantitative statistical results gained from a two-year-sampled content analysis. On the other hand, qualitative outcomes are expected to validate, support and expand the quantitative data. In short, although each analysis is to answer a particular research question, the combination of multi-methods would limit the drawback of a single method, bring the strength of each to complement the other for a best understanding of research problems (Balaban et al. 2015). The procedure is detailed as followed.

In the first phase of our study, qualitative method was employed to discover “the current state of science journalism in Vietnam”. Initially, the study uses the analysis of key features of science journalism in the Global South by Nguyen and Tran (2019) as a benchmark to evaluate the professionalism of science journalism in Vietnam. It aimed to present and discuss the strengths and weakness of science journalism in Vietnam, as compared to other developing countries. Semi-structured interviews probed into the local journalists’ perception and practice, addressing how Vietnamese journalists perceive and perform their roles. Particularly, the thesis attempts to detail the process and method of their news gathering, sourcing and framing, an account of representing global science controversies as well as their attitude towards the science reality in Vietnam. The purpose of in-depth interviews is also to discover journalists and editors’ awareness and capacity, strength and weakness in selecting, investigating, and reporting science issues.

We also asked the participants to direct the factors affecting their journalistic practice, aiming to answer the second research question “What are the key challenges to professional science journalism in Vietnam?”. It sought to investigate the relationship between journalists and the journalistic norms, the newsroom

operational framework and other influential elements on the news production. The challenges facing science reporting were determined by the interviewed data collected from our first phase research. While the former analysis primarily emphasised data manifesting the science journalism's status, the latter lent further understanding to the causes of such circumstance. By reflecting the journalists' advantages and disadvantages in coping with the newsroom managers, their colleagues, scientists, policymakers and influential stakeholders who involve in, affect and control over the media representation, in-depth interview aimed to assess the internal and external factors against the journalists' effort to keep public informed and engaged in life-changing scientific and technological discoveries.

From this initial exploration, *in the second phase of the study*, a mixture of quantitative and qualitative methods was used as a follow-up method to describe how the journalistic practice is reflected in the news output - science controversial stories. First, thematic content analysis was employed to elucidate how the beliefs, attitudes, knowledge and practices of Vietnamese science journalists manifest in their science news output. Content analysis is highly appreciated as an effective method to objectively and systematically explore the specific characteristics of the manifest communication content (Bryman 2012). It is often used to discover the amount and nature of reality presented in the mass media, such as newspapers, audio, video clip or social media post. By examining the media text, the method allows researcher to draw inferences about the message, the communicator, the audience and the context surrounding the visible text (Columbia University Mailman School of Public Health 2019). For that reason, it was employed to expose the stance of Vietnamese journalists on science and technology. By analysing the presence, meanings and relationships among patterns of science news stories, the study would capture the writers' perception and behaviours and provide insights into how the newsroom frame and shape public understanding of science. The characteristics of science news interpreted from the content analysis were then compared with initial insights about science journalists' profession (which gained in the qualitative interview) to draw a throughout causal – inference assessment of science journalism in Vietnam.

In addition to quantitative content analysis, several findings from in-depth interviews with both science reporters and editors about their awareness and experience in framing global science issues, particularly artificial intelligence and genetically modified organism in the first phase of research were taken to discuss and uncover the hidden nuances surround the data of content analysis.

1.6. The approach and structure of this thesis

A mixed-method approach is employed to its full advantage to fill the gap between quantitative and qualitative data. The two first research questions will be approached by in-depth interviews while the third research question will be answered through content analyses of Vietnamese online news representation of two global science controversies – genetic modified organism technology and artificial intelligence. Further information gained from in-person discussion with local science reporters will add to the results of content analysis, aiming to explain several issues undermining the media coverage. Although the data represents Vietnam news media, they will be placed in and analysed in the context of research findings from other developing countries to generate the overall trend in news representation of global controversies in the less developed part of the world. They will also be also used to discuss the implications of science journalism for the development in the Global South and suggest some initiatives to bring science news media to the fore of that process. For a logical flow, the rest of this work will be divided into the following chapters:

Chapter 2 *“The current state of science journalism in Vietnam: Initial insights from in-depth interviews with journalists”*, aims to answer the research question RQ1, providing an in-depth analysis of the position of journalism about science in Vietnam. Using data from semi-structured interviews with nineteen reporters and seven science editors in between 2017 and 2020, the chapter will probe into how Vietnamese journalists are aware of the science journalism’s role and function. The key finding is that although science is highly appreciated as a decisive means for the country's poverty elimination, economic and social improvement, science journalism is, similar to other parts of developing world, in low status. Reporters usually have a high normative expectations of science journalism, but little things get done. Their science-reporting disappoint themselves because a lot of the things they consider science journalism must do are not materialised in reality in any substantial way.

Glancing over the practice and development of science journalism the developing countries since 2000s, this chapter argues that science journalism in Vietnam fails to fulfil its critical role for the country's development.

Such low status highlights the need for an extensive examination into the barriers to good science journalism in Vietnam. Chapter 3, "*Underlying challenges to science journalism professionalism in Vietnam*", will present further data from the semi-structured interviews to find out what obstacles lead to the low level of professionalism in Vietnamese science reporting. Aiming to answer RQ2, the findings show a number of challenges from within the news media: newsroom leaders' indifference to science journalism, the shoddy work and pay condition for science journalists, and the increasingly low ethical standards of Vietnamese journalism. Further, the chapter points out doing thorough, deep-digging science journalism is extremely difficult due not only to the above formidable internal obstacles but also a range of critical challenges from outside the news industry. The growth of the resourceful and powerful PR industry is one such challenge, especially given that Vietnamese newsrooms are in increasingly deep financial troubles. Additionally, two other pervasive external forces: the political elite, which holds a tight grip on science reporting, and the science establishment has involved a somewhat uneasy relationship with the news media. Placing all the findings in the literature of science journalism, the chapter concludes that apart the common obstacles challenging science journalism in the West, and even in the South, political control and the rise of unethical practice are pellicular pressures Vietnamese science journalists are struggling to uphold its norms and functions. The burden of science journalism at the heart of development becomes heavier as legacy media are losing their readership. The chapter suggests professional training and coaching as potential initiatives to enhance journalism's long-standing roles as well as to prepare journalists for the twenty-first century media changes.

The second part of this thesis attempts to uncover the status of Vietnamese science journalism by looking at its output, particularly its coverage of science controversies. Chapter 4 "*The representation of global scientific controversies in the media*" aims to provide an overview of how science controversies are selected and framed by media across the globe. The process science achievement is created, and its implications

on human beings are inclined to uncertainty. As such, controversy is recognised as an inseparable attribute of science. Science controversy is therefore employed as a key science concept through which we can explore the media response to not only science nature but also social settings.

Grounding on this fundamental understanding, the two next chapters will delve into the media response to science controversies in developing countries. Vietnamese online media representation of artificial intelligence and genetically modified organisms will be used as two case studies for a more throughout examination of science journalism practice in Vietnam and its implications for the South. Chapter 5 “*Case study 1: Vietnamese news reporting of controversies over genetically modified organisms*” and Chapter 6 “*Case study 2: Vietnamese news representation of artificial intelligence and its controversies*”, will be devoted to RQ3, providing much detailed evidence of how Vietnamese reporters’ perception of science issues reflected in their science stories. These chapters will investigate how artificial intelligence and genetically modified organism technology are selected, sourced and framed in Vietnamese media; and to what extent they are localised in national context. These issues are chosen because while bringing significant benefits, their underestimated risks, at the same time, threaten many aspects of human life. While AI represents a typical emergent controversy of the beginning of the 21st century, GMO reflects one of the most prolonged global scientific controversies over our age. These issues are also in high media concern due to their deep involvement in the relationship between mass media, the public and policymakers (Nguyen and McIlwaine 2011). To assess the coverage of these global scientific controversies in Vietnamese media, the work employed the Google database to search for articles in the two years 2017 and 2018. The data will be then analysed, using descriptive statistics, crosstabs as well as association tests. Going beyond mere descriptive statistics, some qualitative data, including important words or sentences from typical samples, will be recorded to help illustrate and support the quantitative content analysis result where necessary. The chapters will additionally use several examples extracted from the in-depth interview with science reporters to supplement and explain the findings of the quantitative content analysis.

Finally, chapter 7 “*Towards a better future of science journalism for development: Vietnam and beyond*” will summarise the main findings of the study. Combining the data from the previous chapters together, the thesis will first discuss the key characteristics of science journalism in Vietnam, then move to potential gaps between a widely held belief of science journalism in the South and its actual practice in Vietnam. From this, it will present some potential solutions to foster science journalism into the core of development processes. Throughout this, it will argue that a fundamental training is in need for the improved professionalism of science reporting in Vietnam. Further, placing the results in the historical development of science journalism and the twenty-first century’s media evolution, it will discuss the future of science journalists and newsrooms in Vietnam. This chapter will end with the thesis’ limitations, implications, along with a call for future research for a more comprehensive understanding of science journalism in the Global South.

Chapter 2

THE CURRENT STATE OF SCIENCE JOURNALISM IN VIETNAM: INITIAL INSIGHTS FROM IN-DEPTH INTERVIEWS WITH JOURNALISTS

The history of specialist science journalism can be traced back to the late 1890s when scientists in Europe and the US called for a wider public understanding of their research (Nelkin 1987). At that time, several US science magazines chose to publish science lectures and their opinion on national phenomena (Dunwoody 2008). Rensberger (2009) called this first phase the “gee-whiz age” of science reporting, in which science writers defined their roles as a mere science advocate, bringing novel development from the science ivory tower to the wider public rather than going beyond the science wonders for any analysis on its implication for society. Due to the increasing evidence of science side effect, in the second phase 1950s – 1970s, science journalist moved from the role of an informer and an educator to the role of a critical watchdog, questioning the motivation and long-term political and social implications of S&T on human beings (Rensberger 2009, Angler 2017). The 1970s saw a significant media interest in science. However, according to Rensberger (2009), the booming period of US science journalism has ended in 1980s with the fall of science magazines and science section. Although the situation may vary in

different culture and the number of science reporters has increased in many countries, science journalism takes an inferior part in most of the newsroom (Dunwoody 2008). Especially in the current digital age, when traditional newspapers have no longer maintained their diadem, science journalism is facing more challenges in upholding its vital role for science communication. If it overcomes these impediments, science journalism, as discussed in Chapter 1, would be a key driver to the global development. In an ideal sense, science journalism not only acts as a vehicle delivering mere scientific facts or making them more relevant to people' life but also seeks to expose the potential threats of science and foster public engagement in scientific decision-making processes. In other words, by monitoring, verifying, contextualising and critically analysing science, science journalism helps not only to bring scientific notions, practices and outcomes into daily life but also to enhance lay publics' ability to be critically informed of and effectively engaged with science, including its benefits, risks and policies (Nelkin 1995, Secko et al. 2013, Angler 2017). In the absence of a strong science journalism, developing countries, who are more often receivers than producers of science knowledge and technological innovations, are particularly vulnerable to being left behind the world since the media are usually the major – sometimes the only – channel for public communication of science in these countries (Nguyen and Tran 2019).

In Vietnam, where the government has acknowledged S&T as the “*key driver for the national fast and sustainable development*” (Truong 2019), journalism has also been recognised as a key player in preparing people and policy makers to effectively use and make the most from S&T advancements (Nguyen 2014). However, like its counterpart developing countries, Vietnamese science journalism does not have a high profile. The country, which underwent two long wars and then a decade of ideologically driven stagnation, started to see its social and economic life recover in 1986. Since then, observers argue that the media tended to focus on political, economic, and social issues rather than science and technology. Although S&T is found in most national and local newspapers, specialist science beat is not established in newsrooms. Compared to economic, political, social issues and to the critical role of S&T for national development, there is very little space was allocated for science (Nguyen Dinh 2013, Dao 2017). In accordance with its low profile, most science stories are covered in forms of gee-whiz stories with that lack of depth and

critical mindset (Nguyen Dinh 2013). Anecdotal evidence shows that local journalists lack professional knowledge and practical skills in dealing with science. For example, according to Phan (2008), Vietnamese journalists were not familiar with science notion, making it hard for them to informing public about scientific complexity. However, there has been no detailed investigation into how Vietnamese science journalists perceive and perform their roles. The practice of science journalism in Vietnam, similar to other parts of developing world, remains an under-researched area.

In the Vietnamese-language literature, Tran (2016) and Dao (2017) are among the rare studies examining science and technology communication in Vietnam. While Tran (2016) analyses science message in two TV shows, Dao (2017) provides an outlook of science and technology popularisation in online media. Although the two studies consistently reveal an absence of critical science reporting in Vietnamese news media, they do not provide fundamental views and principles on good science journalism. The term science journalism is, indeed, not mentioned in the two studies. Journalism, according to the authors, is rather a conduit for promoting science advances and state policy than a means to critically analyse and alert citizens and policy makers to S&T risks and benefits or to organise and lead public fora over science and science-based development policies.

In the English-language literature, there are little research into the professionalism of science journalism in Vietnam. There are just a few studies about Vietnamese news media coverage of climate change (Pham 2007, Shanahan 2009a, Pham Thu 2011, Freeman 2017) and biotechnology (Karembu et al. 2009, Le and Navarro 2011). In terms of climate issues, research consistently reveals a low media interest during the early to mid-2000s. However, the latter half of this decade has seen a general rise in Vietnamese news coverage of environmental phenomena. According to these studies, the media swift transition can in part be attributed to their increased awareness of the importance on climate change after the 13th Conference of the Parties (COP13) in Bali 2007. This growing media attention to climate change can further benefit from the increasing state's support as well as the active leadership of newspapers to the work of environmental journalism. Most of the studies suggest that Vietnamese news media often link environmental stories to subjects of politics

and policymaking while the governmental official is the dominant source of information. Politicians and state employees, such as the Ministry of Agricultural and Rural Development and the Office of the President, at the same time, are also the top sources cited in Vietnamese newspaper coverage of biotechnology (Le and Navarro 2011, Asoro 2012). With such domination of political sources, it is unsurprising that biotech articles mostly support the government initiatives and highlight the hope of genetically modified organism technology, discussing GMO as a powerful force to drive Vietnam modernisation, diminish the trade deficit, ease concerns about economic instability and make the country a significant leader in Asia. While the media exhibit a basically generic and neutral tone in GM coverage, there is a shortage of critical analysis on the potential risks of GM plants and crops, digging beyond the data to look at the people favouring GM and their conflicts or interests. Effective science journalism, as a journalistic genre bringing the advancements of science works from the laboratory to the public spotlight, educating the lay people without formal education, ensuring the readers to be critically informed about scientific prospects and suspects and engaging them in science policy and progress, likewise, is hardly mentioned in the academia. Only several anecdotes evidence the local journalists' appreciation for science journalism but, at the same time such grey literature show their failure in raising local public awareness and preparing policymakers to make well-informed decisions regarding the science issues. Nguyen (2014) is the only empirical study on perceptions, professionalism and initiatives of science journalists in Vietnam to improve science reporting. Yet this publication has been restricted to certain circles of the World Federation of Science Journalists. The scarcity of research leaves a noticeable gap in our understanding of Vietnamese science journalism and its ramifications for the Global South, particularly how science culture in a particular country converges with/ diverges from its counterparts in both developing and developed parts of the world.

Aiming to address these gaps, this chapter uses Vietnamese media as a research site to further understand the characteristics of science journalism in developing countries and evaluate the extent to which science journalism fulfil its critical role for national and global development. Positioning Vietnamese science journalism in the broader context of developing countries, the chapter focuses on the first research question **RQ1 “How do Vietnamese science journalists perceive their**

professional roles and contribution in Vietnam’s development processes?”

which is divided into two sub-questions:

- ***RQ1a: How Vietnamese science journalists perceive the professional role and function of science journalism?***
- ***RQ1b: How Vietnamese science journalists assess the quality of science journalism in Vietnam?***

Based on the general understanding of how journalists in the South perceive of and deal with science and technology, the study assesses the current status of science journalism in Vietnam.

2.1. An overview of Vietnamese news media

Before probing into the practice of science journalism in Vietnam, this section will provide a snapshot of the Vietnamese media system. To explore science journalism in the changing media system in Vietnam after country’s renovation in 1986, I argue that the constraints of the party-owned but market-oriented press system has contributed to the journalists’s quandary to uphold their normative expectations of a professional journalism in Vietnam.

Before 19th century, journalism was not a recognised concept in Vietnam (Tran-Huu 2015). According to Tran-Huu (2015), the first Vietnamese-written newspaper Gia Định Báo which was sponsored by the French, was established in Saigon in 1865. In the next five decades, journalism started to develop in Vietnam with the emergence of a few prints. The period 1921 – 1954 saw a dramatic rise in the quantity of publication with 729 newspapers were published by Vietnamese editors-in-chief in both Saigon and Hanoi – the two social and economic hubs of Vietnam. Despite this flourish, in the infant stage of Vietnamese journalism, the quality of newspapers was not highly appreciated. 81% of the total 750 newspapers were closed after three years while 41% of those were closed just after a year. Due to the shadow of the French regime on Vietnam, newspaper in the colonial era was dominated by the

French media value and practice, which emphasise on the political involvement and interpretive, explanatory and commentary news reporting style.

In the period between 1954 and 1975, because of the two political regimes in Vietnam, the news system was divided into state-owned, following the Marxist ideology in the north and private-owned, adopting the Anglo-American principles in the South (Tran-Huu 2016). However, after the reunion in 1975, as Vietnam was now a communist country, the North's media principles and practices were brought to the South (Marr 1998). The news system, hence, has been consistently based on Marxist-Leninist prototype (Heng 1998, In: Marr 1998). The Soviet communist theoretical framework, which is one of the four models of press proposed by Siebert, Peterson, and Schramm (1956) is also suggested as the suitable model to explain the ideology and practice of journalism in Vietnam. Indeed, the theory is widely employed by many scholars to study the press of Marxist countries, such as China, Vietnam, Cuba, and North Korea (Mai Duong 2016). Although this model reflects the core principles of Vietnamese news media, which is state - controlled and seen as a propaganda instrument, a mouthpiece of the state and party, it is insufficient to use this normative media approach to explain the practice of Vietnamese journalism in the twenty-first century (Huang 2003, Mai Duong 2016).

The country's reformation – Doimoi – in 1986 brought drastic change to not only the economy but also the social sphere in Vietnam. In the fresh air of Doimoi, along with the collapse of Soviet Union in 1991 and the transformation of communism countries since the post-Cold war, Vietnamese press is transformed from the role of pure “propagandist, agitator and organiser” to that multifunction of “informer, educator and instructor” to the ordinary citizens (Dinh-Hang 2004). The end of government financial subsidy to news media in accordance with free market-based economy has shifted Vietnamese media to financial autonomy through advertising and circulation. According to Dang (2012, p.63), “for the first time, Vietnamese journalism had to serve two masters, the Party and the audience”. Further to this climate, globalisation and rapid Internet penetration has eased the state authority margin, creating an open space for the media with the emergence of citizen journalism (Nguyen 2009). Although citizen journalism, in the forms of blogs, personal webpages, and social media accounts, are unable to create any pronounced change to Vietnamese press,

it has wakened the mainstream media to transform itself, from a mere propaganda report to a more public conversation. While fostering critical engagement and civic action on public affairs, it contributes to the democratisation process and development in Vietnam. Like the communist neighbour China, it is demanding for a transitional approach rather than a single model with a single philosophy to understand the mixture of state-own but market-oriented news system in Vietnam demands (Huang 2003). Applying Hallin and Mancini (2012) comparative dimensions to media in the non-Western world, I will describe below the ideology and practice of Vietnamese press in four dimensions: the development of mass media markets, political parallelism, journalistic professionalism, and state intervention on media.

- The development of media market: Emerging and developing along with the major historical upheavals of the two wars, Vietnamese mass industry is still young and fledgling. After the reunion in 1975, given that Vietnam newspapers were state subsidy, there was not a competitive media market in Vietnam. Yet, the landmark renovation (Doimoi) has turned Vietnamese newsrooms into profitable enterprises, relying on readership and advertising revenue for survival. A media market has established in Vietnam, which Hochiminh city (formerly Saigon) contributed one third of the national newspaper market both in terms of the number of newspaper and the number of copies published (Tran-Huu 2016). Although there was an increase in the newspaper titles with more than 10 million copies released in the period 1986-2013, only 35% number of newspaper sale per 1000 adults nationally in 2007, below the world average and even other countries in the Southeast Asia (Tran-Huu 2016). This low level of readership gives the impression that Vietnamese media market is like the Polarised Pluralist model of media in the Southern Europe. The mixture of state-owned but market-oriented has resulted in the overlapping existence of two press sectors: the party-press which maintains its financial dependence on governmental subsidy and the market-driven newspaper which bears its budget on newspaper sales and advertising. While the party-controlled paper chiefly serves as means of communication among the political elites and the politicians with the wider public, the mass-appeal paper primarily focuses on ordinary people and subjects to human-interested topics. Notably, several newspapers, i.e. Tuoi

tre (The Youth) and Thanh nien (The Young People), which are not state-funded and does not deviate from the party line but their content is more liberal-oriented. They act as elite broadsheets in the Western media, raising public awareness of and concern on important current affairs. However, under the faction and economic pressures, these newspapers occasionally fall in the trap of unethical practice. Several examples which will be analysed in the empirical chapters parts of this thesis are evident for this unethical exercise.

- Political parallelism: According to the Press Law 2016, as the mouthpiece of the party and the state, the principal functions of Vietnamese media are advocating, popularising, constructing, and protecting the ideology of Vietnamese Communist Party (CPV) and governmental policy (Press Law 2016, Article 4.1, 4.2). Given that the press is tied to the party and state institutions, Vietnamese news media truly manifests all characteristics of a party-press parallelism system which Zhao (2012, In: Hallin and Mancini 2012) uses to describe China media. In tandem with the state-ownership, it is common, if not compulsory, for media managers of national newspapers and public broadcasting organisations (i.e. Nhan Dan – The People, VTV- Vietnamese Television, VOV – Radio The voice of Vietnam) and provincial dailies (local newspapers published in each province) to be party elite officials. Conversely, selected media executives are also promoted to senior party leaders. The equivocal distinction about the role of an independent journalist or a state agent makes journalism apparently a propaganda tool for the party.
- Journalistic professionalism: Before reformation (Doimoi), Vietnamese journalists merely serve as a propaganda tool for the CPV. Under the state-controlled regime, the media lack of autonomy and independence of practicing their watchdog role as commonly acknowledged in the Western media. Indeed, as journalism school was only opened in the 1990s, a formal professional accountability has not been well established in Vietnam. Furthermore, most of curricula equip students with too much dogmatic and outdated theories rather than journalism professional skills¹. The Press Law, which was amended several times over the years, provides insufficient notion

¹ Based on observation of author – who is journalism lecturer in Vietnam

about professionalism. In a similar vein, the Code of Conduct issued by the Association of Journalists (2016) primarily focuses on enhancing the media accountability to the state rather than imposing the basic standards of professionalism. The news media have not grounded on vital principals of truthfulness, accuracy, objectivity, impartially, fairness and public accountability (SPJ 2020). Consequently, professionalism becomes a fragmented ideology which each journalist would adopt and construct accordingly to their specific circumstance. The low level of professionalism makes Vietnamese journalists more vulnerable to commercial pressures. Market-newspapers become tabloidized while journalists are driven to sensationalise news to gain readership. News outlets is influenced by PR resources while reporters become PR practitioners whose voices assist the vested groups rather than public interest.

- The tight political grips on media: Despite significant changes have been made since the benchmark renovation (Doimoi), the CPV continues to keep its tight grips on Vietnamese media. First, although the state cuts down funded sources to majority of news organisation, there is – at least in theory – no private news media in Vietnam. State-owned media outlets can cooperate with other private entities in the process of media production, but, as the Press Law 2016 states, “the head of a press agency must take responsibility of all associated press activities” (Press Law, Article 37). It is commonly found newspapers which are managed by private enterprises but issued by governmental bodies or public associations. For example, *Vnexpress* is owned and run by FPT – an IT corporation but issued by The Ministry of Science and Technology; *Forbes Vietnam* is licenced by Forbes Media - the owner of Forbes, run by Interactive Media – a local company, and managed by *Bao Van Hoa* – a newspaper belongs to The Ministry of Cultures and Information Policy. When most newspapers are still structurally affiliated with the CPV, the state maintains their authority on the media. Second, although the press is expected to “reflect and guide public opinion; to acts as a forum for the people to exercise their right to freedom of speech” (Press Law, Article 4.2c), the first and foremost role it is required to fulfil in Vietnam is to serve as the mouthpiece of the state and government. The functions of an informer, educator and constructor should be in line with the people and party interest.

Any violation to the Party ideology may result in bill and even arrest. Editors and senior managers of news organisations must attend a weekly compulsory meeting run by the Central Ideology Department to review their published coverage and to be informed about how to report forthcoming sensitive current affairs (Vu 2015, Mai Duong 2020). Practicing under the state tight grip, self-censorship become an unspoken rule in Vietnamese news media, which each journalist is well-perceived of the “dig here but not there” limitations even though these forbidden topics are uncertain and different case by case and from time to time.

In short, economic, political, and social reform has transformed Vietnamese media into a multi-structured media system rather than a single Marxist and Soviet media system. However, the shadow of communism ideology still casts in the media practice. The dilemmas of being an ideological institution under the government control, and as business institutions under the market competitive regulation makes Vietnamese media in general, and science journalism in particular, in a far more difficult to fulfil the role it should uphold for the national development. The remaining part of this thesis will explore such issues and challenges that this media system put on science journalism in Vietnam.

2.2. In-depth interviews with Vietnamese reporters and editors

Initially informed by an unpublished report by Nguyen (2014) on science journalism in Southeast Asia for the World Federation of Science Journalists, this study started with a systematic review of the literature on the status of science journalism in the Global South (Nguyen and Tran 2019) and used the insights from this review to guide data collection on the issues and challenges of science journalism in Vietnam. I conducted twenty-six semi-structured in-depth interviews with nineteen reporters, six science editors and one current affair editor for in between 2017 and 2020 (See Appendix 1). Semi-structured interview is probably the most common qualitative method used to generate a rich and detailed understanding of participant’s perceptions, attitudes, beliefs, and motivations (Bryman 2012). As “the fullest condition of participating in the mind of another human being” (Bryman 2012, p.399), face to face in-depth interview would strengthen mutual communication between researcher and participants which allows the researcher probe into the underlying

behaviour and opinion of the interviewees. As a discovery-driven approach, it provides a comfortable atmosphere for the data collection. It offers a significant advantage for deep information excavation which might not otherwise be achieved in other methods, e.g. structured interview or focus group (Macdonald and Headlam 2009). With these reasons, the method was used to deepen and sharpen our understanding of the professional context in which Vietnamese science journalists operate. Furthermore, thanks to the flexibility of the open-ended question and followed-up interviewing technique, the method encouraged participants to reflect their own perspectives and specific experience in dealing with science and technology. Meanwhile, it also allows researcher to depart from any point of the guideline, follow up the interviewee's responses to develop the significant themes and issues emerging in the course of interviews. Such arising information would enrich our understanding of the underlying reasons and motivations driving journalists' actions and how they interpret their experiences, particularly the issues and obstacles challenging them to do professional science journalism in Vietnam.

The twenty-six interviews were conducted in September 2017, March 2018 and July 2020, respectively. The six-month time gap between the first two periods was intended for the researcher to have a critical reflection on the process of data gathering and analysis. Accordingly, the subsequent interviews would lean on experience gained from the prior interviews. The third round of eight interviews in July 2020 was not in the original plan but was deemed as necessary and pertinent because they provide an opportunity to focus on the responses of Vietnamese journalists to the unprecedented rise of Covid-19 and its impacts. This is an attempt to exploring how scientific, ethical, social, economic controversies over Covid-19 travel across the global media. It is expected to bring the voice of the a less developed part of the world to the debate around an ongoing universal scientific controversy.

Reporters and editors who represent both broadcasting, print and online news media were chosen to cover multiple perspectives on salient issues and challenges from different levels of experience and seniority as well as to gain a thorough understanding of newsroom dynamics in relation to the production of science news. Of twelve reporters participated in the first and second rounds of interview, six had

been trained in SjCOOP Asia, a World Federation of Science Journalists' mentoring project that aimed to build capacity for science journalism in Southeast Asia during 2012-2014. On balance, the SjCOOP and non-SjCOOP science reporters would provide some insights into whether, and how, professional training could make a difference to science reporting. In the second round of interview, seven frontline journalists and one editor who were responsible for reporting Covid-19 pandemic were interviewed to enrich our understanding of news presentation of an existing scientific controversy.

A protocol of interview guideline was formulated for the interviews. Initially, a set of lead and supplemented questions, as well as the instruction guiding the interview, was composed. After several revisions, it was tested in several pilot interviews to ensure the questions covering research focus but being consistent with knowledge of interviewees. However, in order to gain a deep, rich and nuanced results, the interview structure was developed flexibility which allowed the interviewer and interviewees to discuss a particular topic in a broad area of interest. Excluding personal identity (name, age, gender, working institution, working experience), non-direct questions were primarily developed in the research protocol in order to avoid binary answers. Open-ended questions were used to encourage participant to manifest their underlying attitudes, beliefs and values that it is hard found in yes/no questions. The purpose of unspecific question is further giving avenue for arising issues during the fieldwork.

The questions which were used to explore how science journalists and reporters perceive and practice their profession² were usually asked before questions which probed their attitude towards the professionalism of science reporting in Vietnam³ (See more details in Appendix 4). However, the interviewing order varied by case, as followed the preparation guided by Bryman (2012, p. 473): the interview should "create a certain amount of order on the topic areas, so that your questions about them flow reasonably well, but be prepared to alter the order of questions during the actual interview". Interviewees were also encouraged to give examples to support their points of view. Especially, they were asked to manifest their perception and

² Please explain your understanding of science journalism; What do you think about the role and function of science journalism?; Please describe your news reporting process; What criteria influence your news selection and construction?; What pressures are you facing in your newsroom?

³ How do you think about the professionalism of science reporting in Vietnam?; How do you evaluate the support of scientific community for science reporting? How do you think about the impact of vested groups on science reporting?

experience in covering specific controversial issues, such as climate change, vaccination artificial intelligence, genetic modified organism. Eight participants in the third round of interview were particularly asked to share their experience in reporting the ongoing COVID-19 pandemic.

Before taking part in the interview, potential participants were informed about the research project before taking part in the interview. The average duration of an interview was about sixty minutes, while the longest discussion took two hours forty-five minutes and the shortest lasted twenty minutes. Interviews were recorded with the participant's consent and were fully transcribed for the analysis.

In terms of procedures, this study adopted approaches from previous studies (e.g. Guenther and Ruhrmann 2013) to divide each interview into three parts corresponding to three levels of influences on journalism practice.

- At the individual level, we explored perception, interest, knowledge and skills in selecting, assessing and presenting science in the news. In particular, the interviewees were probed for normative expectations of the professional roles and functions of science journalism, the ethical principles that they uphold in science reporting, their relationship with sources, and the common strategies they employ to overcome difficulties in covering science news. They were also encouraged to reflect on specific cases and examples to identify how science should or should not be reported in the local media.
- At the organisational level, we explored the impacts of communication routines – such as news values and norms, editorial process, newsroom regulations and hierarchies – to obtain an in-depth understanding of science news selection and exclusion processes in Vietnamese newsrooms.
- At the social-system level, we asked participants about how they work with other stakeholders – such as scientists, policymakers, lay public, interest groups, PR industry, civil-society organisations and so on – in producing science news. In particular, the cultural, political and social contexts in which participants were operating were probed as potential facilitators for or challenges to professionalism in science journalism.

Data analysis

After transcription, the interviews were manually thematic analysed on Nvivo. Some journalists were willing to be identified in the report while most refused to make their names published. For this reason, we decided to use anonymous quotations in the whole report, employing signals A1 to A6 to represent science editors, B1 to B13 to represent science reporters and C1 to C6 to represent science reporters who participated in SjCOOP training project. Additionally, A7 was used to describe the editor who responded for Covid-19 pandemic reportage, B7 to B13 were used to describe the reporters who focused on Covid-19 pandemic reportage (See Appendix 1). The core-theme and sub-themes were identified and extracted from data by reading and re-reading the transcripts. Based on recurring themes within the data, this study captures interviewees' insights in relation to the research questions. Direct quotation is also used to illustrate the participants' viewpoints and values.

It must be noted that not all our interviewees were able to articulate all these issues in fine detail. This is in part because many, especially those who had not been through any specialist training like SjCOOP, did not have a clear or adequate concept of what science journalism is. In fact, in the early stages of their interviews, two participants even categorised academic publishing as a form of science journalism (a recognition that, sadly, does exist in the country's media laws). However, together, the twenty-six interviews in this project allowed us to reach a theoretical saturation point where the various issues raised by our interviewees, all of whom had some experience in reporting about science, became repetitive without new insights. Hence, the findings presented in this work will form a valid, trustworthy account of the state of journalism about science in Vietnam.

2.3. High normative expectations of science journalism

The crucial role of the news media in shaping public perception of and attitudes to science is well documented in the Western literature (Bauer et al. 1995, Bucchi and Mazzolini 2003, Williams and Clifford 2009, Schafer 2010). Nelkin (1995) states that science journalism not only informs lay publics about new science developments but also helps them have a good grasp of and a prepared response to uncertain science and technology issues that bear direct relevance to daily life. Along with the growing demand for citizen engagement with science and science policy-making, particularly in areas where science contests socio-cultural values, science journalism has been

increasingly tasked to place a stronger focus on the processes beyond science to include multi voices and perspectives in coverage (Nguyen and McIlwaine 2011, Hibberd and Nguyen 2013). In developing countries, where people do not have as many opportunities to access informal science education events and platforms often seen in the West – such as science museums, exhibitions, festivals of learning – research has found that journalists tend to see informing audience about scientific advancements and promoting science literacy through classroom-like transmission of scientific facts as the most important functions of science journalism (Shanahan 2009a, Aram 2011, Navarro and Hautea 2011, Du and Rachul 2012, Dutt and Garg 2012, Nguyen and Tran 2019). For example, a large number of studies reveal Indian journalists perception of doing science journalisms is to inform, educate and enlighten the audience about science and technology, especially the issues with a direct impact on daily life, such as public health risks (Mercado-Martinez et al. 2001, Nichols and Chase 2005, Bertrand et al. 2006, Ashorkhani et al. 2012). Similar appreciation is acknowledged in Sub-Saharan countries (Joubert 2007) where a majority of respondents in an empirical studies is found to rate “promote public literacy in science” as the most important task of science journalism as lay public are too distant from the complex science (Appiah 2012, Balleh 2012). By the same token, Mercado's exploration (2012) on the media representation of climate change in the press demonstrates that Argentinean journalists have comprehensive perception in promoting environmental issues. In addition to the press, television is considered as a key platform for science literacy promotion as several investigations on Brazil TV news find that majority of public declared TV as their prime source of science and technology (Jurberg, Verjovsky, Machado, et al. 2009, Ramalho et al. 2012, Castelfranchi et al. 2013). Science journalism is defined as a channel for scientific and technological messages to be transferred from the laboratory to the common audience. As science interpreters, the news media define the content and set the agenda for public perception and judgement towards science complexity. Not only acting as the most essential channel for science knowledge, recent studies in China (Fang 2014), India (Moghariya and Sardon 2014) and Nigeria (Asiyanb 2015), however, have noted some moves beyond the information and education functions – such as embedding science into local/daily life and enhancing public engagement in science policy-making.

Sharing much the same condition as other developing countries, our interviews with Vietnamese science journalists show a similar normative perceptions and expectations about the role of science journalism for Vietnam's development.

First, most interviewees argued in one way or another that science journalism should play a central role for the national development. Although S&T is highly appreciated as the most effective means to improve the relatively backward socio-economic state which is an outgrowth of the long closed-door policy in Vietnam, it has yet been placed in the instrumental position for the nation-building process. More importantly, the low levels of science and development, low public literacy and unstable policy to promote S&T progress have restricted its contribution to development. By enhancing public understanding of S&T and its importance for development, connecting and engaging different science stakeholders, i.e. scientist, government, public, business, in science process, journalism wants to push S&T to the heart of development. In supporting this argument, some participants identify a wide range of fields that good science journalism could make change, such as climate change mitigation, agriculture productivity, health care system improvement and so on. One participant emphasised "In my opinion, by enriching public understanding of a specific science issue or fostering the S&T implementation in a particular social and economic area, science journalism could increase the national living standard, prosperity and sustainability." [B5]

Second, in order to do so, the interviewees saw a necessity for journalism to play a key role in educating and informing the public with S&T updates and related issues. In Vietnam, the citizens usually lack fundamental knowledge of science since apart formal education at school, many normal people, especially those living in the rural areas, find it hard to access new science updates from other science communication platforms, e.g. science museums and exhibitions or science festivals and events (Phan 2008). Thus, journalism is recognised as an instrumental force in popularising science and improving public science literacy through keeping people informed of and interested in S&T events and issues. In several S&T issues, especially those having direct relevance to the public daily life, e.g. food safety, health and medicine and widespread impacts on both individual and society levels, e.g. climate change, natural disasters and medical epidemics, nuclear power, more than disseminating

science knowledge, the interviewees saw their principal duties is to educating their readers to a better recognition and appreciation of several contemporary scientific and advanced technological issues and their underpinning role.

Further, conscious that Vietnam primarily adopts science knowledge and technological innovation developed from more scientifically advanced countries, the interviewees saw the need for journalism to play its central role for “science gate-keeping”, i.e. to take a lead, alongside science institutions, in helping their people and organizations to be well-informed and critically-alerted about S&T benefits and risks before making any implementation of foreign S&T developments. Particularly, several emphasised the importance of journalism in equipping the public and policy-makers with essential informational tools to deal with controversial science issues such as nuclear power, genetically modified crops, artificial intelligence, and so on. “We should not merely report on global science risks and benefits; we need to explain what they might mean for Vietnamese society and how they should do to implement” said one interviewee [A2]. They wanted journalism to act as a prime vehicle of information and advice for their people to properly deal with these impacts both at micro-individual and macro-societal levels. In terms of macro-level, journalism should drive politicians and state agencies towards a stronger emphasis on science and evidence-based knowledge in all policymaking processes. Further, as one interview said, “science journalism concerns not only on macro-societal level, such as science policy making but also on micro-issue affecting each individual, such as the impact of robotics on labour market, how textile workers might lose their jobs to automation and what they should prepare for such potential change” [A1]. Finally, it is raised by several participants that an oft-perceived mission of science journalism is to use the news to attract public, especially the young citizen to science. “Science journalism has to encourage audiences, particularly young people, to be interested in and engaged with science,” said one interviewee [A2]. A couple, albeit not a majority, went a little further, calling for science journalism to empower people to monitor and control the nation’s science policies and its development-related trajectories. “The broader mission of science journalism is to inspire the public to voice their opinions in science issues and the policy making”, one said [A4]. By connecting citizens, businesses and governments with science, they wanted to push science to a central position that it deserves but has not enjoyed in development.

With such normative visions and strong aspirations to put science and science journalism at the heart of development, however, our interviewees faced an almost opposite reality, raising grave concerns about the status of science journalism in Vietnam. Many of these issues are in common with other developing countries and will be discussed below.

2.4. Heavy dependence on foreign sources

Despite its vital role in defining the content and setting the agenda for public perception and judgement towards science complexity, the existing literature shows a low profile of science journalism in the developing countries' media. Science coverage was heavily dependence on foreign sources, especially the Western media while little interest was paid on local news (Shanahan 2006, Joubert 2007, Tagbo 2010, Dutt and Garg 2012). The majority of science publications in African media was translated from European or North American news stories (Shanahan 2006), with little or no contextualisation (Tagbo 2010) and few discussions from local scientists (Joubert 2007). Likewise, developing parts of Asia have been found to capture most of their science news from the Western wire services. One key reason for such reliance on foreign sources, as Joubert (2007) emphasised, is that big science achievements are seldom discovered by local researcher or produced by research institutions within their countries. When such rare cases happen, local science researchers often prioritise to publish their discoveries in international academic journals. As Cameroon journalist Buma Gana admits, African "scientists are unknown at home" (as quoted in Shanahan 2006, p. 392) since good African academic research is normally published in the West rather than within their countries of origin (Shanahan 2006, Joubert 2007). The repackaging of science news from Western media is particularly common in stories concerning global science controversies as local journalists find it more difficult to seek domestic experts' voices on those issues (Joubert 2007, Tolan 2007, Han et al. 2017) In many cases, science news is "republished without enough concern in adequating to local reality" (Massarani et al. 2005, p.5).

With the same reasons, Vietnam science journalists acknowledged their failure to seek for good home-made science journalism. Instead, they compensate for such shortage by filling their news space and air-time with science stories and

documentaries from outside the national border. All the interviewed journalists observed that most news about new science and technology developments that Vietnamese audiences receive is translated and duplicated from foreign sources, especially the Western media. One science editor admitted that “copy and paste” is so popular that it is now taken for granted in Vietnam’s newsrooms. While it was agreed that these international stories help to increase science awareness and knowledge among a small science-active segment of the public, our participants pointed to a number of critical issues that might limit the public’s ability to understand and engage with science.

First, there is a high possibility of science stories being mistranslated. While it was not possible for interviewees to cite any general indicator of such mistranslation, some were quite certain from their experience that such errors creep up quite often but mostly go unnoticed in the newsroom. A range of reasons were offered, including, first and foremost, the fact that translators lack basic science knowledge, journalistic verification skills and even language proficiency. Meanwhile, most of the interviewed science journalists admitted that they have long struggled with language barrier to reach the foreign science knowledge. Indeed, “it is an unspoken rule in Vietnamese newspapers that journalists are not required to be good at English”, C4 said. “Only around 20% to 30% journalists who graduate from media schools are good at a foreign language”, estimated by A1. Foreign science stories are, therefore, merely translated by interpreters rather than reported by science journalists. It is common to see scientific rumours in Vietnamese newspapers “because the interpreters themselves can’t validate the news source”, added C2. More often, scientific findings from other places was repacked in too celebratory, fearful or excessive language forms and styles for domestic consumption. And as many international stories are translated and published without any source credit, it is very hard for interested readers to track and validate the accuracy of translated information at stake if they want to.

Sometimes such mistranslation can be disastrous. Nguyen (2014) cited an incident in 2007 when several newspapers published stories translated from *BBC Online* and *Daily Mail* about new US research that finds women eating a certain amount of grapefruit have a 30% greater risk of breast cancer. Soon after this was circulated in

the media, the whole local market for grapefruits collapsed, with consumers boycotting them out of fears. It was later found that the grapefruit sample in the related research belongs to a species that is not grown in Vietnam. Four news organisations were eventually fined for publishing these stories, but by then many poor local farmers had suffered a huge economic loss from the boycott. In this study, participants also adduced several detrimental impacts of insufficient translation during the Coronavirus pandemic. Several conspiracy theories about the origin of and treatment for the virus could be classical example of the news media gullibility in translating foreign science news. Given the rapid diffusion of information, particularly rumours, fake news, hoaxes in social media, misinterpretation around the hazard was amplified, reinforcing public negative response, such as anxiety, fear and ridiculous behaviour towards the pandemic (Nguyen and Nguyen 2020).

Second, although when stories are well translated, there is a lack of proper localisation and contextualisation to make them relevant and comprehensible to most people. “Most of the time, we merely translate stories into Vietnamese but place them in no national contexts,” said a participant [B1]. This is because translators, without general background knowledge of science and its workings, translators are unable to critically assess original science sources and report scientific facts and stories effectively into local context. Furthermore, according to the interviewees, those in the international news beat rarely collaborate with colleagues in domestic sections to analyse the relevance of foreign sciences to local communities. In addition, it is challenging for them to find local scientists who have the ability and willingness to comment on global science issues, especially topics related to science controversies. Participant A1 added that the absence of local angles is in part because “the world has left Vietnam behind and we are still struggling to comprehend science developments in other countries.”

And when foreign news is contextualised and domesticated, it is not always done with a necessary analytical and critical mindset and, as such, sometimes leads to other types of distortions and misinformation, especially in the cases of health issues such as disease outbreaks or food safety. In 2008, for instance, following a revelation that infant formula milk in China was adulterated with melamine, the country saw a flood of confusing news coverage of melamine-contaminated milk.

Although there was no evidence of the existence of Chinese melamine milk in the local market, many consumers switched off all dairy products as they could not distinguish speculations and facts in the news. Local dairy firms and farmers suffered a period of stagnated sales until about a month after the Chinese incident, when it was verified that Vietnamese dairy products are melamine-free.

The long-term consequence of such overreliance and inappropriate localisation became severely, particularly in case of the national energy security. A veteran reporter criticized his colleagues' heavy dependence on Japanese regulations in their coverage of the risk and benefit of nuclear power. "Japanese believe that their nuclear power is absolutely safe. But let's look at the Fukushima Daichii nuclear disaster. Why should reporters ground on Japanese standard to evaluate the nuclear application in Vietnam?" [C5]. As the Japanese was paid a heavy price for their "unreasonable overconfidence" (Banri Kaieda, quoted in Onishi 2011), added C5, the media repackage of a "safety myth" nuclear power from Japan without appropriate linking to local context would probably lead to a similar penalty for Vietnam.

Concerning the same issue, correspondent C6, on the other hand, questioned about the uncritical adoption of "green revolution" concept in media coverage of nuclear power plant. Regardless the domestic conditions, several newspapers duplicated Western viewpoints in framing nuclear as hazard and calling for a renewable energy replacement. However, "For a rapid developing country like Vietnam, energy is always an imperative issue. Hydroelectricity is exhausted, nuclear power is opposed. Solar power is eco-friendly, but it takes time and money to invest on. If Vietnam stops exploiting these natural resources, can we use kerosene lamp instead of electricity in the next five or ten years, to wait for the success of solar power?" [C6]. Without a critical linkage to local circumstance, the support or opposition to nuclear reactors both lead to public and government lack proper vigilance and adequate preparation to respond to the nuclear power.

2.5. Science journalism in the back-seat

Literature shows that apart from the easy option of translating science stories from the international media, when it comes to domestic S&T developments, *science journalism* in the global South usually takes the *back-seat in most newsrooms*

because it rarely receives proper attention by editors and news executives (Nguyen and Tran 2019). A most salient issue is a general lack of interest or investment in this news beat as editors tend not to perceive science as something to enhance the readership (Mwale 2006, Hien and Navarro 2011, Lublinski et al. 2014). The first formidable challenge for science journalists, according to a UNESCO study (UNESCO 2007), is therefore to convince editors to do a science story. As particularly shown in research in Asia and Africa (e.g. Ekanem 2003, Schanne et al. 2009, Dutt and Garg 2012, Michael and Binta 2013), the media assign comparatively little space to science-related topics. Science stories are often used as space/time fillers, seldom allocated in newspapers' front pages or lead broadcast news bulletins and, are occasionally drawn from the prepress proofing to give the space for last-minute paid advertisements. Further, dedicated science teams and sections are a "luxury" in most newsrooms. In Pakistan, Bangladesh, Nepal and Central America, the media see regular ups and downs, with launches and closures, of science sections and programmes due to the lack of professional will and financial support (Ahmed 2005, Patairiya 2007, Massarani 2014). Even emerging economies such as China, India and Brazil – where the close link between science and economic development is widely recognised and where there is a quite advanced and fast-growing S&T sector – science journalism is not yet a recognised concept, with its practice still facing an uphill battle to establish its legitimacy as just another news beat like politics, culture and sport (Navarro and Hautea 2011, Dickson 2012, Zhao et al. 2014, Massarani 2015).

Similar to the back-seat position of domestic science in other developing countries (Mwale 2006, Hien and Navarro 2011, Lublinski et al. 2014), Vietnamese science reporters rarely enjoy a place that they deserve for the development processes and the nation-building because science journalism has been not yet a fully recognised concept. One interviewed science editor observed that the number of reporters with some specialist expertise in science reporting in Ho Chi Minh City – Vietnam's media hub – has remained unchanged at "around ten" since the last decade [A3]. The six SjCOOP - trained reporters, probably thanks to their generally higher normative expectation of science journalism, were the most frustrated with its current status. Participant C3, for example, contended that science journalism remains "a strange concept" in Vietnam. "Few would have the opportunity to participate in international

training projects such as SjCOOP to obtain a proper idea of what science journalism is about and why it is important,” he said. “The rest – I would say, about 80 or 90 per cent of those who write about science and technology – don’t have a clue of what genuine science journalism is supposed to be.” C6 agreed:

Vietnam doesn’t have science journalism yet. There is an association of science journalists but they mainly duplicate news announcements from the Ministry of Science and Technology. They call what they do science journalism, but it’s not what I would define as such.

Two participants even saw academic publishing as a form of science journalism (a recognition that does exist in the country’s media laws). The flawed understanding was also found in a recent publication about the role of Vietnamese science journalism for sustainability of the public health system amid the COVID-19 outbreak (La et al. 2020). While the authors have a pertinent perception of science journalism’s critical role in the fight against Coronavirus, they mistakenly took academic publication as science journalism while categorising science news as “official press”. For most participants, such lack of proper understanding makes science journalism still face an uphill battle to establish its legitimacy as just another news beat.

In that climate, not surprisingly, very few Vietnamese newsrooms have dedicated science reporters. Most often, those assigned to cover science are general or education reporters who have insufficient levels of specialist knowledge and skills to report science critically and comprehensively. Participant B1, for example, reported that science is embedded in the education news beat in both of the newspapers where he had been working. “In my current role,” he said, “I am expected to take on science stories if/when required but my main job is to cover education.”

The assignment of science reporters is itself quite patriarchal. C6 informed us that, even though he had ended up receiving several science reporting awards in recent years, it was never a career he would pursue in the first instance. “I didn’t want to be a science journalist but at the time it was the only job offered to me,” he said. “It’s not your choice: you are chosen no matter what your strength or talent is.” Even those who have built a science reporting profile over the years, C6 and his other WFSJ-

trained colleagues, complained bitterly that it is hard for them to call themselves science journalists as they often have to write about other areas. C6 observed that “there is no authentic science writer in Vietnam” while C5 believed that “it would be more accurate to call us journalists with a science focus than science journalists” [C5].

The shortage, or sometimes absence, of specialist science reporters becomes problematic in dealing with science and health crisis. Taking the Covid-19 for example, any coverage that lacks scientific evidence support might be costly to society. However, general reporters from Danang city – the hotspot of the second Coronavirus wave in Vietnam – contended that they were assigned to cover the pandemic despite their inadequate knowledge and insufficient skills for science and health reporting. As B9 said: “We are thrown into the Covid-19 storm without any preparation. A Covid-19 beat is founded, but nearly all reporters are from political, economic and lifestyle sections. The only science writer is self-isolated because he had a close contact with an infected case.” Another young journalist, B8, shared his special experience “I am taken to cover Covid-19 even though I’m not a science reporter. I don’t have any contacts of doctors, health managers and medical officials. It was hard at the beginning.” Although the pandemic, which is affecting every aspect of human lives, is not just a science story, it is vital for media coverage of Covid-19 to ground their stories on science as science provides the fundamentals for informed decision. Here, it is truly challenge for general journalists or political journalists to be well-suited in the status of science journalists who are inherently aware of the sophisticated and controversial nature of science.

The low position of science journalists in the newsroom goes hand in hand with the lack of dedicated print space and airtime for genuine science topics. Apart from the massive volume of news about the Covid-19, science reporting is not a part of the daily routine. Indeed, science newsbeat is historically absent in most Vietnamese newsrooms. As hinted above, one common approach adopted by news outlets is to have a combined Science & Education section, where education stories, being closer to readers’ daily life concerns, often dominate (especially during the peak times of university entrance exams and school admission). Otherwise, science is mingled with technology in a Sci-tech section. Yet despite its critical importance for

national development, basic science knowledge is less likely covered than technology achievements and rarely placed in the front page. The most popular stories covered in this section were about electronic appliances, digital devices, hardware configuration, software, Internet cables. “In the former [name] print newspaper that I worked for, on page six, there is an 800-word section allocated for science. In fact, it is dominated by technology”, said A4 - a twenty-year experienced editor who was in charge of science editing in both dailies and specialist science magazine. It was widely agreed among the interviewees that the science’s inferior status is caused by: (1) science is too abstract for journalists to critically understand and explain; (2) science is excessively dry to sell in the market; (3) reporters who covered high-tech could gain more financial materials from the technology industry and retailers.

In order to make science more appealing, some other newspapers merge science and health topics into one section, but the focus is mainly on daily health issues and concerns, such as body processes, nutritional effectiveness, new medicine, food safety, healthy lifestyles, risks of cancers and other fatal diseases and so on. In fact, as Vietnam has one of the world’s highest cancer fatality rates (World Cancer Research Fund 2018), some interviewees referred to cancer-related topics as tips to increase audiences for science news. Sometimes, the lack of a clear concept of science journalism leads to some bizarre treatments. An interviewee said that his newspaper once treated a story about a medical doctor being beaten up as a science one [A6]. Of the few outlets who do opt for dedicated Science & Technology sections, the focus, again, is primarily on the so-called “news you can use” – e.g. consumer information and advice about electronic appliances, digital gadgets, hardware configuration, software and so on – rather than science developments, issues and policies. Several interviewees noted that this is not just because of the appeal of such topics but also because reporters covering high-tech often gain financial rewards from technology firms and retailers, an issue that we will return to later.

In fact, the above represents a step backward from the recent past, when the rise of the Internet and the associated decline of traditional media audiences and revenues have led to the disappearance of many science-focused publications. Some of the

best popular magazines of the 1990s and 2000s – such as *Today's Knowledge*, *New World* or *Young Intellectuals* – have closed down due to financial difficulties. Meanwhile, budget cuts have recently led *The Flash* (Tia sang), a pioneer science newspaper, to be merged with *Science & Development* (Khoa hoc & Phat trien). “Science news is not attractive to advertisers, so it is hard to compete for the resources it needs to survive,” said one interviewee [A3] and was echoed by several participants.

2.6. The dearth of in-depth science reporting

The essence of journalism' job should not end with providing briefings about scientific issues to the audience. Another important role is to provide a comprehensive and critical view on science stories. Yet, alongside the low editorial commitment to science topics, science journalism in developing countries is far from fulfilling their responsibility to challenge science and unveil the unseen stories. From the literature, the dearth of in-depth science reporting in developing countries is reflected in several key aspects. *First*, science coverage is dominated by straight news (Navarro and Hautea 2011, Evans 2015). This overwhelming proportion of straight news suggests an overall preference for episodic, event-based science news over thematic, issue-based stories. The lack of issue-oriented news reporting is particularly common in the lower-income countries, where the news coverage of science issues that have long-term consequence on human being occasionally peaks during certain events (e.g. climate summits, World AIDS Awareness Day) or during short periods of intense debates, but does not last long enough to retain public attention (Pratt and Ha 2002, Shanahan 2009a, Boykoff 2010, Panopio and Navarro 2011, UNESCO 2011, Das 2012, Kakonge 2012, Kuppuswamy and Maheswari 2014). *Second*, a preference of straight news means that there is a shortage of analytical coverage through in-depth journalistic forms as features, commentaries and the like. Literature clearly shows that the media in developing countries often fail to present S&T events and issues with an adequate evaluation of the scientific rigour behind them – such as methodological procedure and strengths/weaknesses, weight of evidence, scientific consensus, ethical conduct, and so on (e.g. (Jurberg, Verjovsky, Machado, et al. 2009, Lü 2009, Du and Rachul 2012, Castelfranchi et al. 2013, Asiyanb 2015, DeRosier et al. 2015, Midttun et al.

2015). One oft-mentioned symptom of the lack of an analytical dimension in science news reporting is the media's tendency to either excessively celebrate the benefits or exaggerate the risks of new science discoveries or emerging technologies (Reis 2008, Shanahan 2009a). Third, to further complicate the picture, there seems to be little effort to improve the quality of science journalism in the developing world. The lack of specialist training is found as one of the major constraints to science reporting. It is common that general reporters are all too often assigned to cover specialist topics such as medicine, climate change, nuclear power, biotechnology, nanotechnology and so on (Shanahan 2009a, Aram 2011, Kakonge 2011, Bauer et al. 2013, Appiah et al. 2015). Without an adequate science knowledge and specialist reporting skills, such generalists are troubled to critically understand, monitor and engage lay people with new science advancements and their implications. Instead of the active pursuit and rigorous examination of science sources, for instance, they often conceptualise and develop stories on the basis of available research reports, press releases, PR announcements or event agenda (Massarani 2014).

From our empirical investigation, our interviewees understood that science has its own weaknesses and held a normative expectation that journalism must serve as a critical independent observer of science's processes, outcomes and implications. The reality, however, was far from that. According to our participants, in-depth, analytical science news only existed in hybrid journals run by research institutions for specialist audiences. Elsewhere, similar to the rest developing part of the world, Vietnamese science journalism tended to take the superficial form short and straight news about concrete one-off events rather than thematic and/or detailed analysis of issues. An editor-in-chief observed that much science news in Vietnam did not go far beyond the level of "basic announcements" from sources, "with little scrutiny". This is especially the case when announcements come from state science organisations as journalists "are likely to parrot what the governmental official says at press conferences". It is partly because, argued by a young journalist, "the editorial board would not validate state source. In their mind, information provided by governmental agencies must be absolutely accurate [C6]". One veteran editor expressed his deep disappointment about his colleagues' upbeat, gee-whiz science reporting "They keep saying "I don't know", ignoring the need to go beyond the science issues whenever I

ask for an analytical story. Their writing is simplistic and episodic, which can only fail to raise public concerns on science issues” [B4].

Even though many were conscious of their professional duty as a critical and independent watchdog of science’s processes, applications and implications, due to their lack of expertise, there was a relative absence of critical questioning in news coverage of science, scientists and science policies. According to our interviewees, Vietnamese mainstream media tended to easily accept above-the-line stories and thus forfeit the verification of facts and the examination of source motives. One interviewee admitted that “if I am invited to a science conference, I’ll snatch the supplied materials rather than seeking for more information” [B3]. This means the lack of reflection on their methodological strengths and weaknesses, the validity of evidence, limitations, ethical concerns such as conflicts of interests and other below-the-line issues. This was widely acknowledged by our interviewees in comments such as the following:

- In my opinion, science journalism has effectively performed its function as an informer but hasn’t done well the job of an in-depth critic ... and a change agent to have a significant impact on science policy and society. [C3]
- Journalism is very bad at helping the public to reach a deep and comprehensive understanding of science. [A4]

This superficiality is clearly seen the news coverage of Covid-19. According to the participants in the second round of our interview, during the first and second waves of Coronavirus in Vietnam, there was a domination of articles focusing on the fluctuation of infected cases, the increasing number of deaths and recovered patients, the socio-economic consequences and political response to the epidemic to news stories analysing the scientific complexity around Coronavirus. Although Covid-19 is not a pure science story which demands for a comprehensive coverage of its socio-economic and political implications, informed knowledge about the scientific complexity around Coronavirus is first and foremost important for public understanding of a scientific controversy. Especially as knowledge about Covid-19 is not rich, and most complete studies about the virus are done in a very short period, there is a risk of false information and misleading conclusion. Science journalists,

thus, need to be more sceptic in covering the pandemic, particularly in providing recommendations. Yet, it is largely contended by the interviewees that, as B8 said, “we run for the facts and numbers. In between, we give a substantial focus on the social and economic loss”. There is a lack of news examining the real value of testing or scrutinising the efficacy of mask, the impact of chlorhexidine or malaria drug chloroquine for Covid-19 treatment, the potentiality of Russian vaccine and so on. One explained their incapacity to provide an in-depth reporting to Covid-19 is because “the virus is too new and controversial that we have no choice than relying on WHO and Vietnamese Ministry of Health for scientific argument” [A3].

Indeed, the shortage of critical science coverage is not particular to epidemics. It is raised with the most frustration and more often than any other problem. It is an inveterate issue that is very popular in Vietnamese science newsrooms. Instead of going through a complicated multi-stage investigation, to most of Vietnamese newspapers, the coverage contains no reflection and discussion on the research methodology, evidence validity, remaining limitations, conflicts of interests and other below-the-line stories. Mainstream science writers tend to uncritically accept above-the-line stories due to their incapacity to evaluate scientific reasoning. A reporter who has well-perception of science journalism, C3, lamented “Science journalism has yet done well the job of an in-depth critic to look beyond the data and a changed agent to have significant impact on science policy and society”.

Further, without a strong evaluative and analytical dimension, like what observed in other developing countries, science reporting in Vietnam seldom strikes the right balance between facts and values and between scientific rigour and lay enthusiasm. Most of the time, Vietnamese journalists display an excessive celebration of science novelty without contextualising it. Meanwhile, new discoveries and innovations are often framed in favour of their benefits and in negligence of their potential risks. In the area of artificial intelligence, for example, several interviewees were disturbed by the lack of analytical coverage of its potential negatives. “For example,” one interviewee [C3] said, “my newspaper recently published a series of stories about AI, all just to celebrate its advantages and its role in the 4.0 revolution. Very few are concerned enough to report on or analyse the many potential negative

consequences of AI, such as the possibility of robots replacing human labour and causing unemployment.”

When risk is mentioned, it is usually magnified or sensationalised to attract public attention. According to many participants, it is very often to find unproven food danger, health risk or environmental hazard in the Vietnamese news media. A veteran health journalist confessed:

In Vietnam, if you follow the news, you are likely to find that you might die of cancer some day because of the daily foods you eat. And the best way for many to move on is just to ignore these scare stories and let it be. They are paralysed. [A6]

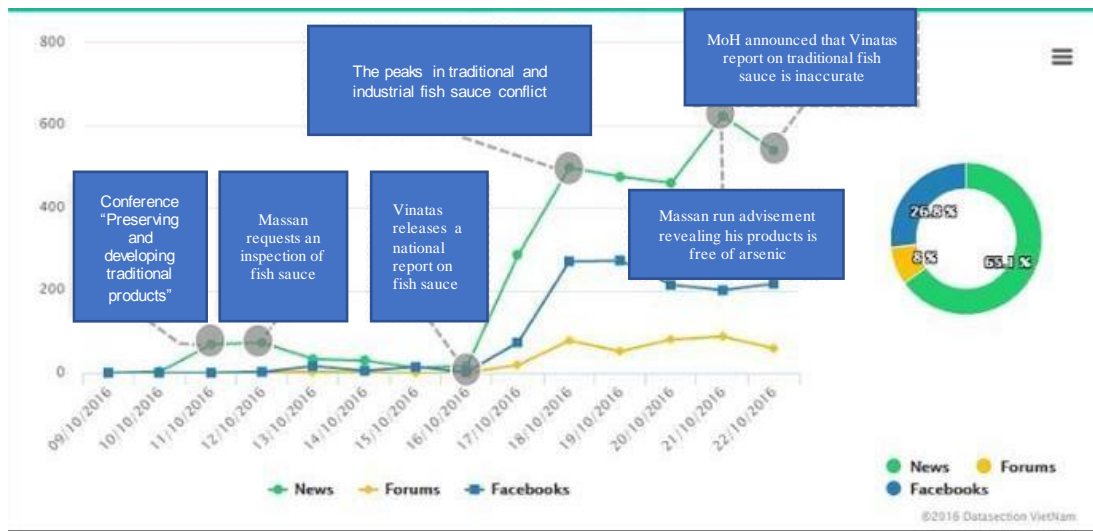
Vietnam has seen occasions in which local economy is severely afflicted due to false risk claims in the news. In October 2016, *Thanh nien (Young People)*, one of the country’s most influential dailies, published a series of online stories claiming, among other things, that the Vietnam Standards and Consumer Association (Vinatas) had found from a survey that 95% of its collected fish sauce samples in Vietnamese market contained an arsenic level that exceeds the safety limit⁴. It also reported that 85% of traditionally produced fish sauce samples from 88 enterprises did not meet the safety standards. Given the central position of traditional fish sauce in everyday Vietnamese life and culture, the news was promptly echoed by more than 50 other news organizations and widely spread on social media (with 44,000 posts, 95,000 shares, 108,000 discussions and 63,000 comments from October 12nd to October 23rd 2016)⁵. Soon after, authorities found that the Vinatas report, which was based on a non-representative sample of fish sauce, was actually sponsored by Masan, a corporation that sells industrial, chemically processed fish sauce (in direct competition with traditional, organically produced one). Of course, not all journalists were malicious in this case. Participant B2 and C6 linked most of the misreporting to the lack of verification under intense pressures of making science appealing to the audience. According to B2, many journalists were both naive and careless, rushing to amplify the malicious survey results without checking what was behind them:

⁴ <https://thanhvien.vn/thoi-su/thanh-nien-cao-loi-va-go-bo-bai-viet-ve-nuoc-mam-758049.html>

⁵ <http://www.khuatquanghung.com/truyen-thong-nuoc-mam-chuyen-bay-gio-moi-ke/>

Even veteran journalists and prestigious newsrooms fall into that trap. The story was so hot that they forfeited their duty to verify things. I was there on that day and saw my colleagues throw all kinds of information they had on news pages to attract views. Nobody bothered with checking the fact [B2].

Figure 2.1. Timeline of fish sauce incident (Source: Datasection Vietnam)



On the other hand, C6 – a veteran science reporter – severely criticised the journalist’s thirst to be first in the competition for breaking news. “Disregarding due diligence process, they needed to get their stories posted as quickly as possible, because a dozen, or even more, news organisations would publish the same story right at the second Vinatas report was released.” [C6]. Moreover, he added, “they immediately echo the arsenic threats to catch audience attention. While their journalistic success is measured by click, accuracy, fairness and news worthiness were defeated by sensational headline, drama narrative. They report science, but their practice is unscientific”. Along the journalists’ naivety and negligence, C6 also censured the irresponsibility of science editors for media amplification of arsenic risks:

In order to limit the reporter’s mistake, the science editor needs to have his/her own double fact-check. When the story goes through the desk of editors, these gate keepers would look for the hole in sourcing or logic. But in

this case, they give too much credit to the “flawed science” report and let the disinformation easily get through their gates.

Another case in point is a recent media frenzy around the threat of benzoic acid to human health. In late April 2019, Japanese authorities in Osaka recalled over 18,000 bottles of Chinsu chili sauce imported from Vietnam for containing benzoic acid concentration over the level allowed by Japanese food safety authorities. Several newspapers took care to point out that the amount of benzoic acid in Chinsu sauce was deemed high by Japanese criteria but were acceptable under Vietnam food safety regulations (as well as FDA and CODEX), but they were the exception rather than the norm. The possibility of benzoic acid causing cancer was excessively amplified in most news coverage, frightening many consumers who were not well-equipped to engage in science debates.

For those who well perceived the significance of critical science reporting, their factual verification is not always done with a necessary of analytical and questioning process. They often rely their source examination on Google database. Regardless Google is appreciated as the most convenient and useful search engine, it is uneasy for journalists, who usually lack scientific knowledge and critical thinking, to validate the overwhelming open-accessed and unauthorised information scraped from this free database. Added to the overreliance on the Internet, scientists are regarded as the most credible referee for scientific evidence check. A common response by our interviewees is that when they are unable to assess the scientific findings and their impacts, they often take academic voices for granted. “When they are struggling in validating scientific evidence, journalists often let experts speak up and let them respond to the provided information” [C2], participant C2 disclosed the common ruse when reporting unknown science. Although it might work in some ways, journalism is a much more complicated affair of adopting information. In most cases, raw information hardly reaches journalists by their own. Scientific information is, otherwise, often manipulated by human sources, including the academia. Although dependence on resources is the nature of journalism profession, it is necessary for journalists to question the science source, as well as the circumstances and background of the story presented by scientists. Also, the overreliance on a particular scientific viewpoint with no scepticism probably leads science reporting to

the fallacy of incomplete evidence which ignores data or facts representing the opposite perspectives.

2.7. Concluding notes

The findings in this study went somewhat against the widely held belief of science journalists as naïve cheerleaders of science in developing countries. Similar to their colleagues in the Asian, African and Latin American news outlets, most of the science journalists and newsroom leaders in Vietnam hold quite strong professional views on the relationship between journalism and science. They wanted this relationship to contribute to nation building through serving the interest of the public – not of the science establishment, or anything else – first and foremost. They did want to inform and educate people about science, but not always in science's favour. They wanted to promote science to a central position in development but at the same time, they wanted to watch it closely to ensure that such promotion is well deserved and does not move too far away from the common good of the public and, ultimately, of the nation. However, what makes them somewhat different from their colleagues in other developing countries is the frustration that they highly expected science journalism to do much but can get little done. Science journalists often depended on foreign sources for S&T information. When it comes to domestic S&T developments, science journalism in Vietnam usually takes the low position in most newsrooms because it rarely receives proper attention by editors and news executives. The lacked support from their news organisation as well as their inadequate expertise to go beyond S&T complexity and uncertainty makes Vietnamese science journalism far from a critical independent observer of science's processes, outcomes and implications.

From a practical perspective, the commonly held image of the easily manipulated science journalist in Vietnam is not a myth. Strong professional attitudes are the necessary but not sufficient condition: for good science journalism to take off, those attitudes need to be encouraged and fostered in an operational environment that favours them. However, initial observation from literature review reveals that there was an absence of such an environment that could foster science journalism in

Vietnam to a high level of professionalism. In the next chapter, the author will probe into the challenges facing science journalists, analysing the obstacles, both from inside and outside the newsroom which are inhibiting science journalism in Vietnam to meet their developmental goals.

Chapter 3

UNDERLYING CHALLENGES TO SCIENCE JOURNALISM PROFESIONALISM IN VIETNAM

As analysed in the previous chapters, science journalism plays a critical role for every people and nation across the world to reach S&T updates and make rational decision to scientific controversy. The role of professional science journalism is sorely important in the Global South because the South – which are so-called developing countries – are often S&T receivers than developers. Yet the practice of science journalism remained underdeveloped in these countries. Nguyen and Tran (2020) pointed out several focal impediments pursuing the professional practice of science journalism across the area, i.e. the lack of basic science and journalism training as the most common obstacle facing science journalism in developing countries, the lack of mainstream media interest and investment in science, the influence from vested non-science interest, such as political, corporate, religious and civil-society groups, the political grip on science journalism and the ineffective relationship between scientists and journalists.

Similar to other developing parts of the South, science journalism in Vietnam has not reached a high level of professionalism. Chapter 2 has pointed out a strong desire of Vietnamese journalists to position science journalism in the central of development. However, they fail to make journalism an effective mechanism for critically informing public about science updates and engaging them with science and technology process. Local newspapers heavily depend on foreign sources while domestic science news is rarely covered in the news pages. While genuine science journalism is still at its infancy, there is a shortage of expertise reporters who has adequate

knowledge and skill to fulfil the role of science journalism. As a result, there is little print space and airtime for dedicated science topics. Instead, most of the coverage focus on “news you can use”, e.g. consumer information and advice about electronic appliances, digital gadgets, hardware configuration, software and so on – rather than science issues, debates and policies. Alongside the faint existence of science in most of the newsrooms, Vietnam journalism has seen the lack of comprehensive, critical science news reporting. More often, Vietnamese science journalists take the superficial form short and straight news about concrete one-off events rather than thematic and/or in-depth analysis of issues in form of analytical or investigative feature and the like. Without a strong evaluative and analytical dimension, science reporting in Vietnam seldom provides a balanced assessment of the science work, validated scientific evidence or investigated research strengths in tandem with limitations or flaws that researchers themselves do not expose. Instead, Vietnamese journalists display an excessive celebration of science novelty and negligence of their potential risks. In order to address the root of Vietnamese poor state of science journalism, it is in need for further throughout research anatomising the obstacles challenging local science journalists to fulfil their roles and functions, the impediments confronting them to take full advantage of journalism to promote science, technology and innovation for the national sustainable and prosperous future. This chapter explores the complexity of science journalism in Vietnam through answering **RQ2**, “**What are the key challenges to professional science journalism in Vietnam?**”, which is divided into two sub-questions:

- ***RQ2a: What are the internal challenges to professional science journalism in Vietnam?***
- ***RQ2b: What are the external challenges to professional science journalism in Vietnam?***

These two issues were analysed by using data collected from in-depth interviews with twenty-six science reporters and editors in the Vietnamese newsrooms. The detailed process of how interviews was conducted and analysed was explained in previous chapter. Primarily, the interviewees were asked to describe their difficulties in dealing with science and technology. They were, particularly, requested to explain their answers by giving specific examples and sharing their personal experience to

overcome the challenges of doing science reporting. Their obstacles from inside and outside the news industry were used as two key themes for our data analysing. The data will be positioned in the broader context of developing countries for evaluating any similarities and differences that science journalists in Vietnam may be facing. From what were known in developing countries, the chapter will present several prime impediments to professionalism of science journalism in Vietnam. Lessons gained from Vietnam case study, in tandem with what was acknowledged in the literature is expected to suggest several initiatives to improve the quality of science journalism in the Global South.

3.1. Internal challenges facing science journalism in Vietnam

As found in the literature, science journalism in the Global South is far from fulfilling its critical role for development. There were two key internal obstacles for the dearth of critical science journalism. *First*, there is a lack of basic science and journalism training as the most common obstacle facing science journalism in the developing countries. While science reporter is widely recognised in Western journalism, such role is almost absent in the developing regions. In the South's newsrooms, general reporters who are deprived of science knowledge and skills are often assigned to cover topics such as medical issues, climate change, nuclear power, biotechnology, nanotechnology and so on (Shanahan 2009, Aram 2011, Kakonge 2011, Bauer et al. 2013, Appiah et al. 2015). Without a specialist training, such generalists are unable to critically analyse and evaluate science novelty and their implications. Instead of in-depth scrutinizing science fact and evidence, for instance, they often frame science stories on the basis of research summary, press releases or event agenda (Massarani 2014). *Second*, added to the dearth of experienced expertise, a lack of mainstream media interest and investment in science makes in-depth science journalism is a scarcity in developing countries (UNESCO 2007, Mochahari 2013, Joshi 2018). Science is perceived as a less important and comparative issue to other daily affairs, e.g. crime and politics that journalists find it hard to convince the editors for a science story's conduction (UNESCO 2007). As reviewed in Chapter 2, research in Asia and Africa (e.g. Ekanem 2003, Schanne et al. 2009, Dutt and Garg 2012, Michael and Binta 2013) show a comparatively little space and airtime the media allocate to science-related topics. It is hardly to see science stories in the lead

broadcast news bulletins or newspapers' front pages. In Pakistan, Bangladesh, Nepal and Central America, science sections and programmes were regularly launched and shutdown due to the lack of professional interest and financial investment (Ahmed 2005, Patairiya 2007, Massarani 2014). Even in China, India and Brazil, three emerging world economic powers – where S&T enjoys a fast development, science journalism is still in its infancy, with its practice cannot compete other news beat like politics, culture and sport (Navarro and Hautea 2011, Dickson 2012, Ramalho et al. 2012, Zhao et al. 2014, Massarani 2015).

Similar to other developing countries, reporters in our interviews confess that despite their high expectation of a professional science journalism, they were impuissant to fulfil the role of science journalism for national development. In anatomising the causes of such poor state of science journalism in Vietnam, our participants pointed to a number of challenges within the news media: newsroom leaders' indifference to science journalism, the poor work and pay condition for science journalists, and the increasingly low ethical standards of Vietnamese journalism in general.

3.1.1. Editors' indifference to science journalism

Of factors inside the newsroom, the most mentioned was the lack of investment in the science news beat. Our participants lamented endlessly about the half-hearted support for specialist science reporting by newsroom leadership. One reason for this, they said, is that most editors lack the necessary knowledge and attitudes to encourage science journalism or “even to appreciate the value of what we are doing” [C3]. In the eyes of editors and reporters in other news beats, science tends to be too abstract to be “newsworthy”. As one interviewee commented: “Science stories are rarely mentioned or discussed in daily editorial meetings. Not many journalists realize that almost every aspect of our daily life is related in some ways to science and technology” [A6]. Stories of science pages being abandoned, and science news being considered “second-class” content were a frequent part of our interviews. One young journalist, B8, found Coronavirus is the rare science story reaching the front page or central position in his newspaper. Yet even Coronavirus is reshaping the world order, it fails to sustain the media attention when the number of infected cases were controlled. “Normally science finds it hard to beat other topics for a position in the front page”, B8 said. The science and education editor of a leading daily agreed,

adding that “there are not many great scientific achievements in Vietnam for us to cover”. As he elaborated, “there are always new things in the lab, but we seldom hear about any breakthrough and exciting practical applications” [A3]. Another less frequently mentioned but noteworthy reason for the lack of specialist science journalism is the general disregard for specialism in Vietnamese newsrooms. Participant A6, as a veteran managing editor, observed that editorial processes shaped more by feelings than by the sort of informed, critical thinking that necessitates specialism. He saw this as not just a peculiar issue of science journalism but a general problem of Vietnamese media:

Unlike Western media, Vietnamese newsrooms do not feel any strong demand for specialist journalism. Editors here, including those responsible for science topics, rise to their rank thanks to their journalistic experience rather than their specialist expertise. Experience is often regarded as the most important, sometimes the only, condition for them to get promoted to editors’ ranks [A6].

On their part, not all newsroom leaders are ready to accept that they “don’t care” about science news. Two editors argued that although they do not have a science news beat, “science is covered throughout the newspaper” [A2] and “merged into every topic area” [A6]. They agreed totally, however, that they are short of the expertise to make science interesting. Both insisted that they had made many efforts, but could not find an effective way to improve the status of science journalism. As one commented: “We simply don’t know how to deal with science effectively to make it reader-friendly. If we did, science would appear in every page, including the front” [C2]. The former editor-in-chief of a daily similarly revealed that he had once run a science section, but eventually had dropped it. “The section is more a patchy content space than something solid and attractive,” he recalled they don’t know how to cultivate their roles as science editors: “We are stuck at having expertise to manage science beat.” In sum, from the perspective of the interviewed editors, the issue is not that they “don’t care” but that they “don’t know”.

3.1.2. Poor work and pay condition

Our interviewees complained very often about heavy workloads as they are increasingly asked to cover too many topics and on too many platforms. The pressure is not only to produce more content but also to do it faster under an intense competition. “Journalists run for breaking news and overlook fact-checking”, said one participant, citing the arsenic fish sauce scandal as an example. “They are facing increasing competition pressures both from other staff within their newsroom and from other media outlets.” This provides a fertile land for what is known in Western journalism as “churnalism”. As one veteran journalist shared: “I don’t want to backbite my colleagues, but ... their schedule is fulfilled by the event-agenda. They spend all of their time on attending events, which remaining is for in-depth investigation?” [B4]. In such situation, ironically, those who are trained to do in-depth journalism – including analytical and critical science journalism – are amongst the most disadvantaged. As two SjCOOP alumni said:

- Before I did SjCOOP, the editorial board always praised me for good performance. However, my work is deemed less effective afterwards. I can’t write as many stories as I did before because I always demand more time for factual verification and in-depth exploration. [C5]
- I always find it harder to report science than my colleagues. Whenever I attend an event, it takes me days to dig out the facts beneath the surface whereas others just snatch or massage the press release into a news article. [C3]

In parallel with that is the prospect of poor pay under the audience metrics-based reward system that has become popular in Vietnamese newsrooms. Vietnamese journalists are traditionally paid on a story-royalty basis (on top of a basic salary) and, with the intrusion of audience analytics into this pay system, therefore, they have a financial incentive to “do less for more” – i.e. shorter, less complicated stories for more readers. “No matter how useful or useless your story is, pageviews play the most crucial role in a reporter’s performance evaluation and reward,” said C5. As science is not among the best-selling topics, science writers often receive less pay than their colleagues, which encourages them to go for the sort of “news you can use” above and discourages them from analytical or investigative reporting of complex science topics. The consequence, as our journalists contended, is not only

the side-lining but also trivialization and sensationalisation of serious science in the news. Science news increasingly succumbs to tabloid journalism styles. Very often, events or issues are dramatized by focusing on either shocking details or conflicts to arouse readers. For example, said one editor, “it is common practice to add mysterious catchy keywords to headlines to sell the news, such as “*A poison found in Pharaoh crypt cause scientist’s death*” [A1]. Particularly, *Coronavirus, Covid-19 and Sars-CoV2* have been used as the hyperbolic clickbait terms to lure the viewers during the current pandemic, such as “Foods to help keep you healthy amid Coronavirus” or “Nicotine therapy for Coronavirus”. In order to generate the readership revenue, even a top online newspaper in Vietnam – Zing News⁶, accompanied with a local leading manufacturer foodstuff, ran a series named “Food and Nutrition in prevention and treatment of Coronavirus” which exploited public fear for their commercial interest. Despite that the series provides audience with helpful information, its tricky title distorts the essential principles of truth, accuracy, balance and fairness which science and journalism obligate to. Being often put in in the dilemma between dramatized reporting to attract readers and balanced reporting to uphold journalistic principles, Vietnamese science reporters sometimes vacillate between two courses of decision, as confessed by interviewees C5 and B10:

- For example, how would you cover an incident in which the only child of a family dies after vaccination? Some would exaggerate the parents’ depression and resentment to call for readers’ sympathy. Other, more self-controlled journalists would consider reporting it more objectively by analysing its clinical causes, namely whether it was an anaphylactic shock, a medical complication or a medical error. The latter would attract less viewership than the former and the reporter may be paid less royalty for the story. Sensationalism and accountability, which one you choose? [C5].
- Coronavirus is changing the funeral conduction and human reaction to Covid-19 death. When the patient 431 – one of the very first virus confirmed case in Danang city - died of pneumonia caused by Covid-19, the authority insisted on taking charge of his funeral management and organisation. It means that his family was required to observe physical distance and avoid unnecessary

⁶ <https://www.alexacom/siteinfo/zingnews.vn/>
<https://www.allyoucanread.com/vietnam-newspapers/>

contact with the body. However, due to the misery for their beloved, his family tried to follow the hearse to the crematorium to see off the deceased. A video clip posted on Facebook showing that they were crying a lot while a family member, wearing personal protective equipment, kept wailing and praying in front of the hearse. So, as a journalist, what should I do? It's easier for me to dramatise the family members' affliction, but as a critical reporter, I should consider the guidance for Covid-death's funeral, providing important information to help bereaved families, friends make important decisions during the pandemic. Otherwise, science journalists would analyse potential risks related to or scientific evidence so far of transmission of Coronavirus through the handling death bodies of confirmed Covid-19 patients [B10].

3.1.3. Rampancy of low ethical standards

Most of our interviewees were outspoken about the increasing ignorance of journalism ethics as an immense obstacle for good science journalism. For historical and political reasons, Vietnamese journalism has traditionally been operating on a very loose ethical base, with most newsrooms following no formal code of ethics and often making decisions on the basis of vague ethical concepts (Nguyen 2014). The Vietnamese Journalists' Association has a generic Code of Ethics that stresses political loyalty as the utmost principle of journalism. Over time, this lack of ethical reflection has led Vietnamese journalists to take for granted many practices that would be seen as highly unethical in many other journalistic cultures. The performance of science journalism cannot escape the restraints of this overall professional culture. Part of the failure of science journalism to be in a poor state, for example, is because basic requirements like fact checking and source examination are not always seen as a must in Vietnamese newsrooms. "Many young journalists do not often verify information, especially when it comes from state organisations," said C6. "Editorial boards don't feel the need to do it either."

A much more concerning problem is the very public acceptance of bribery-like practices. One of these is the so-called "envelope journalism", in which journalists easily accept the so-called "tea/coffee money" from sources during site visits, interviews or press conferences. As Participant B4 observed: "Many of my colleagues don't care what a news event is about. The only thing they do is money.

They rummage for event invitations and look for envelopes when they arrive”. The stronger their network is, the more financial reward they receive. Many journalists take pride in maintaining a strong network with advertising, PR and marketing firms as an indicator of their “influence”. One of our interviewees was rather blunt about this:

I cannot speak for everyone but it’s true, at least for me, that together with investigating and monitoring social issues, I also do journalism for a living. Yet the income of a journalist is not high enough, so I have to gain money from outside. It is impossible to seek for a perfect sense of ethics here. [A3]

Some interviewees, however, raised grave concerns about the impact of this kind of cash advance on the trustworthiness of news. For B4, this could turn Vietnam’s media into a mere PR platform that, in the long run, can only ruin public understanding of science and its contribution to national development. B4 observed that “envelope journalism” has developed to a point that how positive a story is about an event depends on how well paid the journalist involved is. “Sometimes journalists would ignore the event if there is no payment,” he said. On the other extreme, journalists who have received an envelope but later maintain some independence in their reporting would face revenge from PR agents, especially those working for financially resourceful companies. As C4 experienced in following and covering the vastly industry-manipulated debate about genetically modified organism in Vietnam:

A few years ago I was invited to an event organised by Monsanto to introduce its commercial genetically modified maize called bt corn. A few days later, it was largely praised by my colleagues as a breakthrough scientific achievement in their news publications. I wrote three stories, both analysing its benefits to farmers and warning of its potential risks to sustainable agriculture and economic development. I noted in the reporting that GMO was still banned or restricted in many countries. After the series, Monsanto hated me enough to never invite me to any other conference or event.

“Envelope journalism”, however, is only the tip of the iceberg in Vietnamese journalism. In fact, facing immense pressures on revenues and profits, many news organisations have abandoned the most fundamental ethics of journalism to

systematically work for news sources as a way to generate income. An open secret in most Vietnamese newsrooms is that their economic health depends considerably on the so-called “media contracts” with non-news organisations, especially big businesses. These contracts, often done through PR and marketing agencies, stipulate that a news organisation, in return for lucrative sums of money, would do two things: (a) promoting clients’ images and activities as part of their *editorial content* as and when required; and (b) doing no negative coverage of clients during the contractual term. In essence, it is a form of “soul selling”: instead of acting as an honest, independent watchdog of powerful and vested interests in the public’s interest, the contracted media organisation becomes a “mercenary” for them, abusing its legitimacy as a mainstream news organisation to serve the interests of those paying for them. Many journalists, including science reporters, are being pushed into doing the job of PR agents and being muted about the misdeeds of the contracted organisations. Our interviewees mentioned several science-related investigations have been suspended because of these “media contracts”. One recalled his bitter experience when covering an asbestos cement controversy in 2014. He was initially appointed by the editorial board to follow the story of whether fibre that contains asbestos cement could be a cause of cancer. However, after two years of hard work, his investigation was suspended due to the intervention of Vietnam Roof Sheet Association (VNRA), a group representing the interests of cement producers. “I know a media contract was exchanged for my silence,” he said. “It was a very simple way to end a debate in their favour: ... they just need to make just a phone call or to offer a “hush money” deal or a gift and everything is shut down” [C6].

Under “media contracts”, journalists not only become a mouthpiece for vested interests and industry agenda: in several cases, they even collude with unethical PR campaigners to run disinformation campaign. In the aforementioned fish sauce incident, the news media is not innocent. *Young People* and several other titles were exposed to have been paid to engage in a black PR campaign that Masan and Vinatas waged to eliminate its traditional fish source competitor⁷. The campaign was

⁷ *Young People* stopped short of admitting its unethical practices in its final apology to readers, saying it was simply being duped by Masan.

coordinated by a notorious local marketing and PR agency, T&A Ogilvy. The news was soon corrected but by then, it had caused considerable chaos in the traditional fish sauce market.

That was not the first time the Vietnamese press worked in tandem with Masan's black PR tactics to manipulate scientific evidence and sow public fears. Media analysts have seen Masan using the media in many other cases. In 2007, Masan used similar tactics to first spread unfounded fears about 3-MCDP contaminant in existing soya sauce products (including one of its own) and then to launch a new "3-MCDP-free" soy sauce brand, which would quickly dominate a fear-driven market. In 2017, Masan manufactured a controversy over coffee products being mixed up battery, dust and rock powder⁸ only to later introduce a "pure clean coffee" brand. In these cases, things such as accuracy, truth, independence, accountability, fairness and impartiality became a luxury.

3.2. External challenges to professional science journalism in Vietnam

Doing thorough, deep-digging science journalism is extremely difficult due not only to the above formidable internal obstacles but also a range of critical challenges from outside the news industry. While science journalists in the West were confronted by rise of public relation (Murcott and Williams 2012, Ashwell 2016), those in the South were suffering a set of political and commercial pressures that impeding their contribution to the developmental objectives. Interviews with Vietnam journalists reveals these impediments also restrain their effort to do professional science reporting. This section will discuss two other pervasive external forces: the political elite, which holds a tight grip on science reporting, and the science establishment, which has involved a somewhat acrimonious relationship with the news media.

3.2.1. Political control on science reporting

The literature about science journalism in the Global South shows that the political grip on science journalism is a distinctive factor that stands out as the primary reason for the dearth of critical science journalism in these countries. This is reflected in the dominance of political sources in science news (Navarro and Hautea

⁸ <https://www.brandsvietnam.com/congdong/topic/3859-Tu-noi-so-hai-den-truyen-thong-den>
<http://redvn.info/ca-phe-tron-pin-man-truyen-thong-ban-giup-masan-1-lan-nua-doc-chiem-thi-truong.html>
<https://new.s.zing.vn/dang-sau-cuoc-chien-nuoc-mam-ai-duoc-loi-post690954.html>

2011, Asoro 2012b, Midttun et al. 2015). State control methods have various forms, depending on the political system of a particular nation. In heavily authoritarian systems (such as China and Vietnam), the state does not hesitate to use overt control mechanisms, including legalisation, over science news output. In addition to implicitly or explicitly restraining science reporting to certain topics and issues, state actors use tactics to ensure that political sources, including government agencies and policymakers, control the science discourse and debate in the news. State agencies in such countries often make deliberate attempts to restrict scientists from independent involvement in public debates, for fears that scientists might emphasise issues and arguments that are not in line with or even against their science and science-related policy (Jia and Liu 2014). Under such tight political control, scientists develop a high level of self-censorship, tending to avoid participating in media debates for fears of their viewpoints being politically manipulated (Zhang 2015).

In more democratic systems, state intervention into science journalism is often through controlling access to information. Even in India, which is supposed to be the world's biggest democracy, most R&D activities are under the control of the government, presenting a huge challenge for journalists to investigate what is ongoing behind the wall of research institutions (Patairiya 2014). And, as most science journalists work in the public sector, they are unlikely to critically question or investigate the state's national R&D policies and initiatives. Often, that would mean an over-reliance on press releases and research reports from state institutions. Where needed, state agencies attempt to limit public access to state-funded research publications, journalists often find it hard to report certain science topics in more analytical and less descriptive manners. Without independent expert advice, pro-government voices dominate the news, giving the state an easy ride on what kind of science and technology a country should and could adopt or avoid for its own development priorities.

The tight control of political elites and institutions on science journalism is widely confirmed by our interview data. Strictly speaking, Vietnam does not have journalism as defined by Western standards. In the country's Press Law, journalism is first and foremost tasked to be propaganda and mobilisation machine for the ruling Communist Party and its government, above the public information and public forum

functions. Informally, journalists are trained to self-censor – i.e. to “dig here, not there” – through daily routines such as newsroom anecdotes, tacit editorial codes, unspoken discipline, reward processes and so on (Nguyen-Thu 2018). Individual government agencies themselves design systems to reward journalists who serve them well. The annual National Prize for Science and Technology Journalism, for instance, is run by the Ministry of Science and Technology in conjunction with the Vietnamese Journalists’ Association, to reward, among others, works that advocate their science policies⁹. The state’s interference, thus, not only soaks into the profession’s ideology but also shapes their routinised practices.

As such, there was no surprise to hear many – if not most – of our interviewees talking at times about science journalism as a mechanism to promote national science policies and campaigns. For example, regardless of its commitment to independently monitoring powers, one editor of a leading online newspaper, participant A7, proudly told that his news outlet was chosen to partner with the Vietnamese Ministry of Health in the state communication campaign to combat COVID-19. Often, as one interviewee observed earlier, that is understood as treating science information from state agencies as truthful enough not to check. As one senior editor at Vietnam News Agency acknowledged: “We are tasked to act as a spokesperson for government. Thus, state information is often the most valid source that we base on in our reporting” [A1]. This – together with the fact that journalists are not equipped to handle science controversies and their associated policies – explains why Vietnamese science news tends to be in favour of benefits and strengths and to downplay risks and drawbacks. As C6 commented:

Under authoritarian control, journalism is seen as a means of state propaganda. The press pays little attention to science risks ... because state agencies do not want to bring them into the public gaze. And the risks are not urgent, so they don’t care.

The political tight grips on media is more apparent through news coverage of Covid-19 controversy. The Ministry of Information and Communications releases an official dispatch, No267/BTTTT-TTCS, ordering journalism to promote the government action against the pandemic. According to the strict edict, the press is only permitted

⁹ <http://tiasang.com.vn/-tin-tuc/Giai-thuong-Bao-chi-KHCN-2017-Cac-tac-pham-ve-chinh-sach-khoa-hoc-doat-giai-cao-12395>

to report news which was delivered by state officials. Particularly, foreign news needs to be validated by governmental authorities prior to publication. Further, there is an unspoken list of negative topics that journalists were forbidden to cover without permission from the government. Several participants mentioned the example that their newspapers landing in an embarrassing situation as they reported the first Coronavirus death. B8 told us:

My newspaper, like many others, has to remove the news titled “*Vietnam record the first Covid-19 death*”. The news is then pending until this death is officially announced by the Ministry of Health. We re-post the news, however, adding supplementary information that the patient died of myocardial infarction caused by chronic diseases of hypertension, heart failure, end-stage of chronic renal failure, complications of respiratory failure due to heart failure and Covid-19”.

Participant B8 explained “Even though we all know what is going on, we are forced to publish information from official state news reports or facts once they are certified by the government’s spoke person. It’s impossible to post unauthorized or uncertain information”. Interviewee B10 added “There is no such concern on the inaccuracy or lack of transparency in the number. Indeed, Vietnamese political elites understand information over-blocking would only reduce public trust in the governmental battle against Covid-19. However, information should be made available to the public “*at the right time*”.

The problem, which goes against the journalistic independence, is that a few participants entirely acquiesce in the governmental censorship. According to them, the one-party regime’s mechanism for clearance of the pandemic news would restrain the chaotic sphere of mis/disinformation, which inflames the public panic and affect official efforts to control the virus spread. Even though they see its extreme sensibility, for those who support the governmental overshadow on media coverage of Covid-19, the censorship tactics ensures the national medical system not become overwhelmed by a spread of virus. Notably, due to the immense pressure of the government, they even amplify the Coronavirus hazards for political gain. Participant B11 said “Sometimes, the risk is exaggerated to ensure the lay community not to

underestimate the dreadful impacts of Covid-19 on their personal physical condition as well as the national social, economic and medical security”.

Those attempting to go against the tide would face all sorts of direct interventions. One common approach by state agencies is a friendly negotiation with – or oral order to – editorial boards. Apart from the common circle of post-remove-repost, several others reported having had science investigations blocked due to their opposition to government agenda. “I was in the middle of gathering data and facts for an important health story and was suddenly told to suspend it because the Ministry of Science and Technology intervened to say that they didn’t like it,” said C1.

That, however, does not mean that journalists are always succumbed to what they are told to do. Since the beginning of its socio-economic and political reform in 1986, Vietnam has left certain space for journalism to become a gradually more autonomous and daring profession. Several liberal newspapers, such as *Tuoi tre (The Youth)* and *Thanh nien (Young People)* above, have been pioneering in “pushing the fence” for more freedom, with continuous efforts to balance between working with and against state censorship – or more precisely, between toeing the official line and ensuring the highest possible level of professionalism, especially in their coverage of politically uncertain and debatable areas. Their efforts to adhere to journalistic integrity in science journalism, with occasionally deep-digging coverage of science risks and critical analysis of science policies, were cited as examples in our interviews. Although the space for such relative independence has recently been tightened, our participants continued to praise these newspapers particularly for the creative ways in which they strategically and masterfully approach many science (and other) events and issues to offer more neutral, more adequate coverage without being negatively listed by state authorities.

In the struggle to achieve such coverage, journalists face a range of tactics to suppress information. Participant C1 commented that “the most difficult barrier to good science journalism in Vietnam is the public bodies,” especially when it comes to access to science evidence. On the one hand, state agencies – including science institutions – are subject to the government’s strict regulations on who are allowed to talk on their behalf. On the other hand, some governors and local officials who are assigned as official spoke person, often elude reporters as they are not well-trained

to deal with the media. Due to the less-formalised and less-professionalised communication mechanism for science, public agents are not well-prepared to give comments on several complex and controversial science topics, the as B8 said:

It is like playing hide and seek. The head of public bodies often ignore the interview and pass the ball to their subordinate. They don't want to have their face on TV or their name on the bulletin as they're afraid their inadvertent mistakes would harm their fame.

As such, journalists' requests for information that is deemed sensitive – even in a remote sense – are often rejected. Even when the requested information is not sensitive, public officials have other worries – such as a “slip of the tongue” during the interview – and only grant it on the condition of advanced questions or advanced copies. As A3 explained:

Senior government officials are not open to the media. Even when they don't do anything wrong, they're still afraid their views may deviate from the official line and harm their political status. Many provincial heads of science and technology would only agree to respond to our interviews if the draft is sent back to them for checking. Others ask for questions before the interview. It is never easy.

Particularly, there is an undermined discrimination between state news outlets which operate purely as propaganda mouthpieces, and “more independent” newspapers, which practice their work to serve the public in addition to the political duties. Participants of the both news organisations admitted the media which have closer connection with the Communist Party obviously are prioritised to approach official information than the ones farther removed. B8, reporter of a daily press, said “It's quite often to see a crowd of journalists waiting outside the boardroom as only the national and provincial newspapers and broadcasters are invited to the state caucus meeting. We have to get the necessary information by our unofficial channel” whereas B9, works at a local television station, acknowledged his better access to state sources about Coronavirus: “While our colleagues are struggle with local governmental office, we are among the rare journalists who are permitted to interview provincial heads and medical experts at CDC”.

The situation is, of course, more difficult for critical science journalists. Participant C5 said that his name is even in the “blacklist” of a local authority “because nine in ten stories I report are about their wrongdoings.” Even information that should be legally made public for transparency purposes is not easy to obtain as governmental bodies would create many obstacles, especially when it relates to controversial issues, such as pollution, health controversies, debated public policies, and so on. For example, several interviewed journalists were frustrated that Environment Impact Assessment (EIA) for industry projects is often treated as secret documents that they could only obtain through informal and personal sources. As Participant B2 noted, her reporting of big tourism projects at vulnerable natural areas is always difficult because she needs to fight very hard for background information about their legal status – e.g. EIA reports, project licences and boundary arrangements. When exploring the impact of cable cars on the natural landscape and the ecological system of Fansipan (Vietnam’s highest mountain), for example, she gained no access to its EIA and thus was unable to discuss potential threats with expert sources. Similarly, following massive fish deaths in the North Central sea of Vietnam, the Taiwanese firm Formosa was discovered to have disposed a huge amount of toxic industrial wastewater from its steel plant directly into the sea. When the story broke out, very few reporters could find its EIA report. Participant C5, who was one of those “lucky few”, recalled: “Based on my reading of the report and interviews with experts, I came up with a scientifically evidenced story comparing conditions of Formosa’s marine environment before and after the disaster. But most colleagues in other outlets did not have access to the EIA and had to ask me for permission to duplicate my analysis.”

3.2.2. Lack of cooperation from the local science community

In addition to political control, the ineffective relationship between scientists and journalists is a further obstacle detaining science journalists’ effort to improve the quality of science communication in developing countries. We have seen from the Western context that the science-journalism relationship is traditionally an uneasy, sometimes acrimonious one (Nelkin 1995, Lo and Peter 2015). In the Global South, although more fundamental development issues would demand or necessitate the need for an even closer collaboration between science and journalism, this does not

seem to get any better and indeed can be even worse. From their camp, journalists lament insufficient support and cooperation from the science community and find it hard to keep in touch with local science institutions to follow, monitor and report on new science developments (Appiah et al. 2012, Bauer et al. 2013). On the other side, scientists criticise journalists for frequent misrepresentation, unconscious or conscious, of their work. Being misquoted is a common problem raised about science and health journalism (Olet and Othieno 2015). Added to their low trust regarding the accuracy of science reporting are scientists' wariness that news coverage of their research is not always as positive as they expect (Joubert 2007, Michael and Binta 2013). In some places, such as Nigeria, scientists also distrust the media in part because the latter treat them like mere advertisers and demand them to pay for the publication of science news stories (Ekanem 2003).

Studies demonstrate that the uneasy, untrusting and sometimes hostile relationship between newsrooms and science institutions results from different perceptions of their roles in the communication process (e.g. Jia and Liu 2014, Zhao et al. 2014, Zhang 2015, Ndlovu et al. 2016). Scientists do not regard communication as an important part of their professional duty (Zhao et al. 2014; Ndlovu et al. 2016), seeing the job of bringing science to the mass is that of the media. The few who are aware of science communication as a social responsibility often avoid involvement in such tasks due both to workload pressures and a lack of knowledge and skills to work effectively with journalists and the audiences (Ndlovu et al. 2016). When they do get involved, another set of issues arise, as scientists often place themselves in a superior position to journalists. One common practice by scientists, for example, is to insist on reading pre-published copies and assume their right to make change to anything that they do not like in the stories, which is hard for journalists to accept by their professional standards (Joubert 2007). Further, the two sides differ deeply in their approaches to science framing and presentation. While journalists strive to make science easily understood and appealing by focusing on the findings and their practical meanings for lay audiences, scientists require accurate and non-sensational information, which often demands detailed explanations of scientific caveats, processes and limitations. Further, while journalists must avoid bias and single viewpoints to ensure the norms of balance, fairness and impartiality, scientists criticise them for their inaccurate and controversial science representation. As both

sides attempt to control what information to deliver and how to deliver it to the public, without acknowledging and conceding to the other's ways of working, conflicts constantly occur.

In Vietnam, as the state prioritises science and technology in national sustainable development policies (Nguyen-Tan 2012), it might be reasonable to expect that a close cooperation between science and journalism would come more easily. However, the situation is even worse.

On the one hand, as frequently shared by the participants, there is a shortage of local expertise in many science areas, making it difficult and sometimes impractical for science reporters to find good sources and/or to dig into issues. "In many stories, I go out and look hard for a relevant scientist to explain the science behind the event or issue being reported, but with no success", said C5, who cited as an example of his recent failure to find specialist sources for a story about fragrance pollution in Ho Chi Minh City. Similarly, a science editor was frustrated when describing his team's struggle to find local scientists to provide a localised assessment of the potential impact of global controversial science advances, such as GMO. His criticism of local scientists' expertise is rather scathing:

I personally have met scientists with rather outdated knowledge and expertise in the areas where they claim to be experts, especially controversial science issues. Sometimes, I can expect what they are going to say even before the interview, as they keep giving the same answers every year. I even feel that many of them are not as updated as me in issues such as GMO. Who in Vietnam cares enough about GMO these days to do some original research in this area? No one. There's no single expert or scientific institution doing research on GMO. All what they know stems from foreign laboratories. [C6]

The further danger, as noted by many interviewees, is that several fame-thirsty scientists would seize opportunities to raise their voices in the media about the areas where they have minimal or zero expertise. "Regardless of their specialism, they are very eager to comment on every issue, ranging from history to biology", said a senior editor [C2]. "These omnipotent scientists can only confuse journalists with their useless comments."

On the other hand, in areas where local expertise is available, approaching scientists proves to be challenging. With a few exceptions, Vietnamese scientists are unprepared and often reluctant to work with the media due to a number of peculiar reasons:

First, most scientists do not see the importance and value of making their work known beyond academe and their voices heard in the wider community. “Scientists think their works must be published in academic journals” said one interviewee [C6]. “They are not open to the media because they see their main job is to do research rather than communicate science,” said another [B3]. Some scientists are so modest about their achievements that journalists find it hard to approach. “I once tried many times but failed to persuade a very talented scholar who, according to Thompsons Reuters, was in the world’s top-100 most cited science researchers in 2014-2017 period, said B1. “Genuine scientists would rather do research silently and tend to forget that science is only meaningful when it is juxtaposed with the social, economic and political issues of the time.” Part of the problem, it was noted by most interviewees, is that scientists are rarely trained to work effectively with the media and, as such, are not often well prepared to respond to journalists. Time scarcity is also another factor. As B1 and B8 went on to comment, some leading scientists are simply too overwhelmed at work to have spare time for science communication:

- Some time ago, we tried to interview a doctor whose recent IVF publication in the prestigious *New England Journal of Medicine* makes a great contribution to fertility research. She was willing to talk but after three weeks of waiting, we could only have thirty minutes for our interview during her lunch break [B1].
- In the rush for Covid news, I tried to contact a CDC manager, whom I have a close relationship with, for his opinion on the Coronavirus testing system but he didn’t pick up my call. At the end of the day, he phoned me back and tiredly told me that he had turned off his mobile because too many journalists called him. He was too busy to talk to the media. To be honest, as a journalist, I felt that I had disturbed his work [B8].

Second, in the context of no media training in science institutions, there is always an occupational fear among scientists of their research being misreported, distorted, or sensationalized. “They are very fearful of being misunderstood by journalists,” said

one reporter [A3]. “They keep requesting us to keep their original text in our news articles because, for them, editing makes their work wrong.” In many cases, the extent to which scientists are willing to work with the media depend very much on their personal relationships that are built up over time. It also relies on the journalist’s own status, their experience, prestige and other journalistic resources. Participant B5 said that more experienced reporters like him find it easier to call scientists for data and comments than many younger reporters that he mentors. “Scientists are sceptical of younger journalists’ ability to convey science well”, he said. As a newbie, participant B7 has gone through the experts’ chilly reception. “When I first entered the news industry, I was not welcomed by local scientists. As I myself lack science knowledge, sometimes I hardly understand their scientific argument”.

Third, along the lack professionalised communication apparatus, due to the feminine and collectivism characteristic of Vietnamese culture which highly respects the modest and discreet (Tran 1999, Hofstede Insights 2020), scientists often trap in their ivory tower rather than break their cocoons to reach the audiences, preaching their scientific message to the wider public. Many, if not all, participants said that Vietnamese scientists are afraid of being prejudiced by their colleague for the openness and willingness to cooperate with the media. “Some fellows or teammates might think they are seeking fame and honour”, told B7. They also avoid giving comments on or criticising over their colleague’s work for not to treat on the counterparts’ toes. Particularly, scientists could be brought into derision as they provide inaccurate information. “As scientist is not the know-it-all person, he might make mistake sometimes. However, they would be sneered by other scholars, and the audiences, also” B7 added.

Fourth, for those are capable of engaging in public communication of science, there are a range of other peculiar obstacles, especially organisational factors. For one thing, feudal and bureaucratic structures of science institutions could impede the information exchange between science and journalism. Vietnamese scientists are public servants and, as such, are technically required to obtain permission before speaking in the news. “Spokesperson regulations” – rules specifying who can appear in the public together with their formal job affiliation – were mentioned by our interviewees as a major factor inhibiting scientists from communicating with the

media. That often makes some scientists reluctant to talk or causes delay in their responses to interviews. A participant cited as an example the University of Agriculture, where “all lecturers are stipulated not to use their working titles in any interviews with the press” [C6]. Participant A3 observed that “many scientists are very enthusiastic in the early stage of their careers but after years of having their efforts ruined by these organisational pressures, they retreat to save themselves from troubles, changing themselves from a scientist into a mere civil servant.” Another interviewee agreed from her similar experience, observing that “retired senior scientists are very easy-going and enthusiastic to journalists while, on the contrary, existing ones tend to be reluctant to work with the media” [C1]. As science is heavily politicized and much science information is under governmental control, one participant observed that producing well-informed science stories is a painful task: “It is very time consuming to get the information. Unless they are legally or politically required to respond, it would be hard to get scientists and science leaders to engage” [C5].

Finally, the unwillingness of scientific community to cooperate with the media is also due to the low transparency of their science research and their scare of facing critical questions. According to C6, “the quality of academic research in Vietnam is quite poor. Thus, the scientists are afraid of communicating their work to a wider public” [C6]. Further, as C6 added, “scientists, decision makers and businesses often hide information from each other for fear of their research flaws being exposed”. Several interviewees said that a large amount of unqualified and unethical research could get through all “independent” checking and evaluation gates with the help of financial lobby or political influence. “Too often, the final destination of such research is in researchers’ desk drawers,” said one editor [A3].

3.3. Concluding notes

Despite the strong expectation to put science journalism at heart of the development, our participants lament the absence of an environment that facilitates their work makes science journalism in Vietnam still have a long way to reach a high level of professionalism. In line with previous studies in both developed and developing countries, Vietnamese newsroom leaders pay less interest in science journalism, leading to a poor working condition and low payment for science journalists. Another

factor working against journalists is the increasingly low ethical standards of Vietnamese journalism in general and science journalism in particular. Not only failing to fulfil the basic requirements like fact checking and source examination, but also science journalists fall into an unethical trap which is disguised in the form of “media contracts”, becoming the mouthpiece for vested interests and industry agenda. These internal obstacles are, in tandem with the external pressures from the political tight grip and the unsupportive science community, challenging for Vietnam’s science journalism to meet its developmental needs. Sometimes, as seen in some of the analysed case studies, such underqualified practice brings severe damages to local communities.

In the next chapters, the thesis will probe into specific case studies to examine how these challenges might affect the quality of science message presented in the news media. The thesis chooses genetically modified organism and artificial intelligence as two prominent global scientific controversies which have widespread implications on global development. By exploring how the mainstream media perceive and depict these two issues, this work aims to provide an experimental insight into the current status of science journalism in Vietnam. Since GMO and AI are considered as changed agents for development in Vietnam, a comprehensive study on its representation in the news is efficient to access the job science journalism has done for national development. However, before probing into the case studies, the next part of this thesis, Chapter 4 will equip our study with a conceptual framework of media representation of global science controversy and provide a snapshot of how media, in both developed and developing countries representation of several prominent debates on S&T risks and benefits. Chapter 4, in tandem with Chapter 2 and 3 establish theoretical foundation for two cases study experiments in the remaining part of this thesis.

Chapter 4

THE REPRESENTATION OF GLOBAL SCIENTIFIC CONTROVERSIES IN THE MEDIA

The previous chapters have shown that, in the views of its practitioners, Vietnamese science journalism seems to be far from fulfilling the roles and missions it deserves for development due to a wide range of challenges from inside and outside the news industry. This second part of the dissertation will move to further explore the type of science news output that results from journalists working in such conditions, with a focus on Vietnamese news coverage of science controversies. Controversial science issues, such as climate change, genetically modified organism, nanotechnology, stem cell or artificial intelligence, are chosen here because they are a common attribute of science and they bear direct implications for development in any developing country. Before an empirical examination into Vietnamese news about two specific science controversies (genetically modified modification and artificial intelligence), this chapter will provide a fundamental overview of how science controversies are represented in the media in general. This chapter will start by introducing the conceptual framework of scientific controversy and its nuance, the media representation and the process, attributes of media representation of scientific

controversies. By analysing how these conceptual elements work, it can explore the social response to science debate. Based on this research design, the chapter will review the existing literature about controversial science issues and the media, discussing the overall trend and prime characteristics of science controversies in the global media.

4.1. The making of global science controversy

4.1.1. Scientific controversy: an introduction

The term controversy originates from the Latin word *controversus* which is combined by *contro* – meaning *against* – and *versus* meaning *to turn*. From the original meaning, the Oxford Dictionary defines controversy as the prolonged public disagreement or heated discussion. As science is hardly conclusive itself, there are various approaches to the concept of scientific controversy, depending where one stands and which perspective that he/she takes. According to McMullin (1987), scientific controversy is a continuous public debate between those who represent for different beliefs. It happens “where the consensus of the community breaks down”. Two required conditions for the existence of controversy are continuous dispute and community activity. However, the public disagreement must be worth scientific in both sides of opponent and supporter in order to be named as a controversy. The author categorises scientific controversy into controversies of fact, controversies of theory, controversies of principles and mixed controversies. While the former three are based on the internal scientific disputes, which primarily involved in the variance of data analysis and interpretation, the fourth concerns on the external disagreements on both scientific and non-scientific aspects of the issue. In other words, scientific controversy could be distinguished into pure controversy and mixed controversy in which the latter primarily involves the application of science and technology and its conflicts with moral and political interests. In this scene, it is the conflicts of not only public belief but also the community action. In spite of their high appreciation for McMullin’s distinction between pure and mixed-controversy, Brante and Elizinga (1990) argue in a later study that “there is always a social aspect even in the most internalist of controversy”. The authors define that a scientific controversy primarily concerns with contending knowledge claims where at least one of the parties involves has a scientific status, and the others represents social power.

The relationship between scientific knowledge and social dimensions in a scientific controversy is strengthened by Nelkin (1992), who argues that scientific controversy should be considered in both scientific and political values. It is supported by Freudenthal (1998) confirmation about the contextualization of scientific controversy. Although the scholar tries to develop an understanding of a scientific controversy *sui generis*, he agrees to the traditional viewpoint that scientific controversy is a social phenomenon which involves in political, psychological, cognitive and other determinations. Even “the moral, ethical, or social implications of using science to develop or deploy a technology or to make a particular decision can be more contentious than the scientific findings themselves” (National Academy of Sciences 2017). The classification of pure and mixed scientific controversy is re-defined by Wynn and Walsh (2013) by the concept of intra- and inter-epistemic disputes among scientists and the disagreements between scientists and the lay people, the conflicts between political actors and scientific scholars.

Harker (2015) further divides the concept into genuine and created scientific controversies. According to Harker (2015), a genuine scientific controversy refers to the disagreement among scientists about how data should be interpreted, over which ideas are best supported by the evidence, which are worth investigating further as well as conflicts over ethicality of scientific methodology. A manufactured controversy refers to significant public confusion about the circumstance of science, which may intentionally stem from particular groups’ interests for their own financial, political, ideological or religious benefits. Often, the concept involves *created controversies* between scientists and non-scientists’ evaluations and approaches to the subjects; the debate of scientific applications with its social benefits and potential risks and, what’s more, the dispute between science, ethics and politics (Engelhardt H. 1989, Brante and Elizinga 1990, Nelkin 1995).

Scientific controversy varies through different cultural, historical, religious or political circumstances. For example, GMO is considered a more controversial issue in Europe, but it is probably a more scientific consensus in the United States, or HPV vaccine raises serious concern in developed countries but is a less disputable matter in developing countries. However, according to a recent study by National

Academies of Science (2017), regardless the alternation, scientific controversy is often characterized by three features:

- Controversial science refers to the conflicts among the scientific knowledge and the beliefs, values and interests of individuals and organisations rather than the intra-scientific disagreements.
- Controversy occurs when public is uncertain either in science or its implication or the contradictory scientific messages. In other words, groups on both sides employ uncertainty as a rhetorical tool to form controversy.
- The amplified voice of influenced parties in science representation is to serve their purposes. Different stakeholders involve in the representation of scientific controversy tend to frame their stances on science as advantage which presumably lead to misinformation or bias of science knowledge and value.

Among these features, Dunwoody (1999) highlights that in the area of controversial science, different groups may use uncertainty as a rhetoric tool. Uncertainty is a central feature of science which scholars not only try to eliminate but also to reflect as an absent or uncompleted state of knowledge (Guenther et al. 2015). Scientists can actively construct uncertainty in particular situations and with certain effects to reach their specific goals (Shackley and Wynne 1996, Friedman et al. 1999). In scientific controversy, uncertainty is employed as a rhetoric manner for scientific stakeholders to contend with the opponents who experience the shared condition. Friedman et al. (1999) gives example that scientists may explain their own work systematically and reasonably while highlighting the uncertain state of their counterparts. Similarly, activist groups or even the media may form audience perception by framing uncertainty of science as manageable or unmanageable issues, depending on their viewpoints and motivations in the dispute. It is distinguished into uncertainty of academic community and scientific discourse and uncertainty of public settings (Friedman et al. 1999). In the laboratory, uncertain rhetoric is employed to depict the unknown and limited science status. In public science communication, uncertainty is created by the disagreements of scientists and other scientific stakeholders, including science communicators and influencers.

The discrimination of uncertainty correlates highly with the classification of controversy into forms of pure and mixed or genuine and manufactured controversies.

Researchers have suggested various indicators constructing scientific uncertainty. For example, Guenther et al. (2015) synthesise previous studies on uncertainty that scientific uncertainty originates from the invalidity, conflict and inconsistency of research results. Durfee and Corbett (2004) point out the lack of scientific evidence, absence of multi-sources, sensationalism, simply balance between scientific and non-scientific voices or overwhelming amplification of research novelty are factors forming the uncertain representation of science in the media. Studies found that uncertainty is over-represented in several cases to reach the audience interest (Stocking and Holstein 2008). In addition to the hyper-uncertain reportage whose purpose is to increase the news readership, uncertainty provides more open access for the public engagement in the science communication. Furthermore, when the controversy refers to risk, uncertainty becomes more important rhetoric in the media framing of scientific conflicts. According to Ashe (2013), uncertainty “acknowledges doubt or disagreement about the extent of the risk of an event occurring”. While risk is assigned for the probability of harm, uncertainty is equivocal in the probability of risk. Consequently, the more scientific risk is concerned, the more uncertain media frame such issues. In our contemporary *risk society* (Beck 1992), when “controversies generally hinge on decisions with regard to the relative value of different human goods, such as health or security” (McMullin 1987), it is presumably that the media representation of global GMO, stem cell, artificial intelligence or vaccine – the risky scientific issues which directly affect human life – is predominantly framed by uncertainty.

4.1.2. Scientific controversy in the global age

Globalisation is the process of increasing interaction and integration of people, regions, corporations and states across the globe. Thanks to the development of telecommunication, globalisation removes the geographical, national and cultural barriers between different areas, opening a borderless world of economy, language, culture, science and technology and even risk. Positive viewpoints expect globalisation to improve the interactivity and connectivity of knowledge, trading,

technology which is beneficial for the poverty elimination and socio-economic development. On the other hand, negative perspectives claim that globalisation would destroy the diversity of global cultures, creating a single worldview, and give rise to the dominance of Western imperialism on non-Western countries, increasing the inequality between developed and developing nations (Williams 2011). In particular, while the great achievements of science and technology which mostly originate from Western laboratories are creating new competitive advantages for developed countries, the less-developed parts of the world are facing more risks of lagging behind unless they actively adopt science and technology to improve their labour productivity and economic infrastructure. However, in addition to their potential benefits for economic and social reform, emerging science innovations also carry several uncertain threats that could make developing countries to undertake huge offsetting cost. For these vulnerable nations, the loss associated with science risk could be even greater as their voices are mostly dominated by the more scientifically advanced countries. Despite there is a vast distinct ideas and conflicted arguments on the benefits and drawbacks of global village concepts, optimistic and pessimistic globalisers consolidate that globalisation is a process which “greater interconnectivity is breaking down national boundaries, diminishing differences between nations and peoples and promoting the development of new global structure” (Held 2000, as cited in Williams 2011). In addition to the advantages of interchange, globalisation leads to the spread of worldwide issues including pandemics such as AIDS, SARS or the ongoing Covid-19, climate change or the environment and migration and human rights, which required international journalism to adopt a universal rather than a local perspective on the news of the day (Williams 2011). When the world becomes flat, contemporary scientific controversies are no longer debates concerning a particular country. For example, although genetically modified technology was born in the developed world, GM crops and foods have widespread and significant effects on the developing countries. By improving the nutritional value of food and agricultural productivity, these scientific innovations increase opportunities for developing countries to diminish poverty and hunger and reach their socio-economic development. Their possible benefits on withstanding poor natural resources and environmental stresses is largely mentioned by pro-GM scientists and governments (Key et al. 2008, Bawa and Anilakumar 2013). The application of genetic engineering in agriculture and medicine, however, also

sparked concerns over their long-term uncertain implications for social development, trade impact environment and human safety (Williams 2011). By this, the study regards science controversies as debates on global scale. The dispute about and between science evidence and its entailed implications for social, economic, political, ethical and medicated systems challenges people and states from North to South. Due to their extraordinary and far-reaching implications for human beings, these scientific controversies demand for a broader understanding and greater interconnected reaction between the publics and nations as well as global interpretation by news media across the world. Yet there has been limited understanding of how media in the Global South represent S&T debate. Thus, this study uses Vietnam media as a research site to explore how S&T and its controversies are interpreted by media in the developing countries, aiming to fill in the deficient knowledge of science journalism in the South.

4.2. The media representation of global scientific controversies

4.2.1. *Media representation: a definition*

The conceptual framework for the research draws from the representation theory. Representation, as Hall (1997) defines, “is the production of the meaning of the concepts in our minds through language”. It is the process through which reality is constructed by material forms, including words, images and symbols, or in other words, the process through which *the signified* is interpreted by *the signifier*¹⁰. It objectifies our thoughts about the “real” world of objects, people or events by a system of linguistic code which implies meaning. It is a channel in which meanings are both created and reified by the interaction between language system and mental conception. According to Pickering (2001, p. xiii, as cited in Franklin et al. 2005), representation has “the power to select, arrange and prioritize certain assumptions and ideas about different kinds of people, bringing some to the fore, dramatizing and

¹⁰ Ferdinand de Saussure

idealizing or demonizing them, while casting others into the social margins”. Through its selective lens and filters, representation varies greater or lesser from the “real” world in order to shape the social meanings. It is not about presenting reality but re-presenting it by offering a selection of reality (Stewart and Kowaltke 2007). The authors address six elements of the representation framework: the representor, the time of representation, the purpose of representation, those who benefits from the representation or whose point of view does it support, those who do not benefit or whose point of view is not considered and those or what is not represented.

Based on the concept of representation, media representation can be understood as a process of reality construction through a mediated linguistic system. It consists both depiction of reality and the manner by which the news media re-create reality. Stewart and Kowaltke (2007) reveal that the mediated version of social issues is not a presentation, but a *re-presentation*. Media representation involves in the association between the reality, the author’s mental representation of reality and the linguistic representation of the author’s thoughts. The physical product which is so-called the media content or the linguistic code is the centre of media representation. Devereux (2007) argues that media content is a valuable source for the exploration of social meaning. However, representation consists larger values of media production, audience reception, social, historical context and media environment (Stewart and Kowaltke 2007). Consequently, understanding the complexity of media representation calls for a further exploration into the content construction which includes a wide range of media stakeholders.

4.2.2. Global scientific controversies in the news media: a brief overview

Following the concept of media representation, media representation of global scientific controversies can be interpreted as a process in which global debates around science, including pure and mixed controversies, are perceived, selected, framed and delivered to public. This process consists of two layers of representation: the visible layer is media coverage of science issues, which is manifested in media content; the invisible layer is the process through which science news is produced. This process, which is governed by different stages of gatekeeping, reflects the agenda setting role of the media in framing public perception of scientific controversy.

Recent studies on the media representation of global scientific controversies can be primarily classified into research on the media content and media production. Existing literature shows that while there is a substantial body of research looking at the media coverage of a specific science controversy or comparing the construction of a particular controversial issue on different mainstream media portals, there are fewer studies focusing on the nature of its news production. **Table 4.1** summarises the trend, primary characteristics and gaps of research into media representation of global scientific controversies. As seen in the table, research into the media coverage of scientific controversies focus on how a specific scientific issue is portrayed in the media or compare how it is presented in cross-national media, including: frequency and intensity, frames, sources, tones and final evaluation whereas it provides scant information on how media frame science controversies as an interconnected concept. Studies about the news production primarily examine how different stakeholders, especially science journalists, are involved in the framing of scientific debate and the mutual relationship between journalists and other science establishments in the news production. However, most of the findings are obtained from the newsroom's perspective while there is limited understanding of how stakeholders outside the newsroom engage in science reporting.

Table 4.1. The research into media representation of global scientific controversies (Source: Author's construction)

Study	Aims	Limitations
The coverage of scientific controversy in the news media	Analyse how a specific scientific issue is portrayed in the media or compare how it is presented in cross-national media	Focusing on particular issue. A shortage of studies analysing science controversies as an interconnected concept
The production of controversial science news	Examining how different stakeholders, especially science journalists select, frame and publish scientific controversies. Exploring the relationship between journalists and influenced actors and other cultural, social, institutional indicators constraining journalists in the news production	Lack of viewpoints from stakeholders outside the newsroom Overwhelming focus on biotechnology, climate change, fewer studies concerning contemporary science controversies, e.g. AI.

4.3. Research into media coverage of global scientific controversies

Investigation on the media coverage of scientific controversies have been in

progress since the end of the nineteenth. It has received the most attention in research on the media representation of science. The topics are highly divergent (Schafer 2010), ranging from climate change (Tolan 2007, Kuppuswamy and Maheswari 2014), to biotechnology (Priest 2001, Outram 2010, Du and Rachul 2012) and stem cell research (Reis 2008, Jurberg, Verjovsky, Machado, et al. 2009, Ogbogu et al. 2013), nanotechnology (Lewenstein et al. 2005, Lemańczyk 2014) and others. As discussed in the review on current status of science journalism in developing countries, there has been relatively scant attention to the portrayals of such issues outside the Western world (Schafer 2010). Research shows a majority of existing studies focuses on how scientific controversy is framed by European and American newspapers and relatively rare studies come from developing countries (Nguyen and Tran 2019). The rather thin and disparate understanding about science journalism practice, and news representation of controversial science in the Global South is in direct conflict with the notion of science as a global system (Schafer 2010), leaving a gap in knowledge of how global science issues travel across border through media. Despite of this shortage, there are several tendencies could be extracted from the literature.

First, the literature documents that despite a *fluctuation of science journalism* (Williams and Clifford 2009, Bauers et al. 2013), *news coverage of global scientific controversies remains low over the time*. For example, Schafer (2010) observes a remarkable increase in science stories in the UK and Italy media between 1980 and 2000 but during this blooming time of science in the media, the news focus on scientific controversy was low. Nisbet and Lewenstein (2002) exemplify the inferior status of controversy compared to the rising media coverage of biotechnology in America from 1970 to 1999. In Europe, during these three decades, the number of biotechnological controversy related articles reached less than half of biotechnology reporting. Controversies on risk and benefit of genetic engineering only attracted media attention in the latter half of 1970 as a result of the high intensive social debate on human cloning in the end of 1990 (Durant et al. 1998). Thus, a majority of what was covered as science controversy was often episodic and simplistic. Especially, biotechnology was often announced as a new achievement at the early days of biotech industry. The low profile of science controversy in the media is further acknowledged in a recent content analysis on the BBC's coverage of science

(Mellor et al. 2011), which controversy takes a small part in both BBC broadcast and online platforms. Particularly, BBC channels often give an unequal weight to laboratory-related controversial issues compared to other disputable issues which have direct and long-term implications on human beings, such as climate change and genetic modified engineering. Given the complexity of a new emergent technology, nanotechnology is also rarely chosen to be the salient topic in the media (Friedman and Egolf 2011).

Concerning developing countries, literature also shows a shortage of media covering science controversies. Uzelgun and Castro (2015) agree that while controversy is more likely to attract media attention in the West (Shanahan 2009b) it fails to raise the similar interest in the South, such as India (Billett 2010), Argentina (Mercado 2012) and China (Ren et al. 2014). For instance, Ren et al. (2014) reveal that compared to British newspapers which tend to template vaccine as a contentious and uncertain issue, news coverage of vaccination in China is rarely associated with controversy because “official Chinese science communicators were reluctant to get involved in any open debate on scientific controversies”(Jia and Liu 2014). The low presence of controversy in the media is also documented in studies about science and health in Brazilian television news (Massarani et al. 2005, Massarani and Buys 2007, Ramalho et al. 2012, Castelfranchi et al. 2013). Even a high-demand topic like climate change, African journalists tend to avoid present and analyse as they lack understanding of science and environmental debate is not appealed to the general public (Tagbo 2010, UNESCO 2011, Amu and Agwu 2012). Consequently, when controversy is presented, it is usually shifted to sensationalism to attract audience curiosity rather than to analytically discuss their pros and cons or their uncertainty and implications to human beings. However, literature has seen a sparse exploration of the reasons of such low media interest in the global South.

Second, existing literature reveals *science controversies are not equally concerned by researchers*. While media representation of biotechnological, environmental and medical controversies is highly recorded, there is a lack of interest in research on media presentation of social and humanities sciences or the new innovations. In terms of natural sciences, biotechnology, including GMO technology, cloning and stem cells are the most-covered topics (Durant et al. 1998, Nisbet and Lewenstein

2002). Among these, research on media coverage of biotechnology vary in levels and perspectives of analysis. Especially, when GM soya became a commercial product in 1996-1997 and Dolly the sheep entered the public sphere in 1997, modern biotechnology awakened public attention. Bioengineering is mentioned not only as a scientific issue but also a mixture of social, political, economic and environmental affairs. As the pioneer longitudinal empirical research on the modern biotechnology, Durant et al. (1998) address an overall increase in European newspapers' coverage of biotechnology since 1973. Although the authors find it incapable of comprehensively featuring characteristics of biotechnology news due to the diversity of media discourse in participating nations, the findings pave the way for further intensive studies in the field (Bauer 2002, Nisbet and Lewenstein 2002, Hibino and Nagata 2006, Maesele and Schuurman 2008). For instance, Nisbet and Lewenstein (2002) adapt Eurobarometer's framework to explore press reporting of biotechnology in America. Researchers support the original study (Durant et al. 1998) that biotechnology has gradually attracted a huge media attention across the nineties. These assessments are in agreement with a large number of scholars (Gutteling 2002, Hibino and Nagata 2006, Marks et al. 2007, Maesele and Schuurman 2008) that 'few technologies have received as much news coverage as biotechnology' (Mark et al. 2007, p.183).

In addition to biotechnology, researchers often focus on media framing of environmental debates (Boykoff 2010, Aykut et al. 2012, Bowe et al. 2012, Jaspal and Nerlich 2012, Krøvel 2012, Shehata and Hopmann 2012, Lopera Pareja and Moreno Castro 2014). Jaspal and Nerlich (2012) claim that climate controversy is indeed a polemic contest concerning whether global warming is a nature or man-made phenomenon. In contrast, Aykut et al. (2012) disagree with terming climate change as a polemic debate. It is instead a complicated issue, overflowing into various disciplines, involving different interests and combining a wide range of social, economic, political and ethical arguments.

Among the emergent scientific innovations, there has been a sense of research growth in media reflecting nanotechnology (Friedman and Egolf 2005, Allan et al. 2010, Strelakova 2015). However, Allan et al. (2010) argue that in comparison to its potential problematic social consequences and other hazards, the number of

academic studies concerning on the media template of the new nanoscience is not as large as other controversial science discipline. It can be argued that the media interest in a topic is regardless of its importance to human being, but due to the topic's possibility of being sensational to attract the audience and satisfy the economic pressure of the communication industry. Otherwise, controversy merely attracts media attention if only it is widely concerned in the international sphere.

Third, despite the rise of an increasingly globalised world, *the media reaction to scientific controversy differs across countries*. For instance, Japanese media tend to localise the global attitudes towards genetic engineering by expressing greater concerns on the risks. Especially, emotional frame, which has not found in other parts of the world, is further attached to the Japanese news media portrait of animal cloning (Hibino and Nagata 2006). The impact of social-cultural contexts and economic-political hierarchies on media is supported by Marks et al. (2007) that globalisation does affect media coverage but international events and issues are localised into both the American and British contexts. Although the European countries are supposed to share a homogenous culture and history, media framing of S&T in the Western is indeed divergent. Dutch elite press coverage of biotechnology is less controversial than the British and other European countries because the Dutch government and activist groups are likely to consent in the S&T policy making (Gutteling 2002). Similarly, the Sweden national reporting on risks is over four times higher than the UK, reflecting the national different perception of safety (Rowe et al. 2000). National identities diversify biotechnology into ethical issue in German, but public accountability in Britain and scientific-economic concern in the US media (Listerman 2010). Kim (2011) and Bowe et al. (2012), who also focus on the framing of scientific debate in cross-national media, agree that political, social and cultural identities play important roles in framing scientific issues. Context constrains content, determining a controversy should be presented or eliminated in the media. For example, the absence of a debate culture differs the German press to the UK and US in controversial socio-biology representation (Linke 2011). During the peak time of socio-biology in the Anglo-media, the biotechnology issue was still absent in the German news. Conversely, it became a highly intensive debate in the Germany two decades later. The effect of cultural difference on media representation of scientific controversies across the world is found not only in opinion-leading

newspapers (Listerman 2010) but also in popular press (Maesele and Schuurman 2008), weekly magazine (Neresini 2000) and community newspapers (Rowe et al. 2000, Crawley 2007). Exceptionally, there are several issues being hardly covered in the national newspapers but could conversely become a controversy in the local press (Maesele and Schuurman 2008). There are further optional viewpoints and voices about controversial science presented in the local newspapers which contrast to the rather monolithic content of mainstream media (Crawley 2007). In general, literature reviews suggest that globalisation did influence on news coverage of scientific controversies, but several aspects of the coverage tend to correspond to local particularities. In tandem with agenda-setting, national setting has a considerable effect on media framing of scientific controversies. However, excluding the European research on biotechnology, there is a lack of analysis on how the global scientific controversy are represented in a wider range of nations. Further studies on how the news media in the South frame their national reactions to global scientific debate is still absent in the communication studies.

Fourth, a majority of study employs content analysis to study the press coverage of a particular scientific controversy. There is a lack of evidence on how scientific controversies are portrayed in other media platforms, such as television, radio and digital channels even it is argued that these platforms are more accessible and feasible gateways connecting public to scientific issues (Nucci and Kubey 2007, Ramalho et al. 2012). Görke and Ruhrmann (2003) are among the few scholars discussing the relationship between entertainment and journalism in the presentation of genetic engineering. The researchers mention visual media and infotainment as important means of science communication. In a later empirical study on television programme coverage of scientific uncertainty, Guenther and Ruhrmann (2013) reveal an opposite finding to previous studies which mention the absence of uncertainty in the media that uncertainty and controversy are central to the coverage of molecular medicine in German television. Scientific evidence is employed as an instrument to identify the framing of uncertainty, showing that scientific uncertainty and controversy, scientifically certain data, daily medical risk, and conflicting scientific evidence are the four dominant frames in the German science TV clips. However, scientific evidence cannot be used to analyse (potential) contradictions between the lines of media discourses. The study also lacks concern in social

aspects of controversies. In accordance with broadcasting medium, the popular newspapers, magazines and entertainment media depiction of controversies have been seldom considered by the scholars, excluding several studies comparing the difference between tabloids and magazines and the leading newspapers in covering a controversial issue (Rowe et al. 2000, Crawley 2007, Maesele and Schuurman 2008).

In tandem to the North, the South has seen a similar shortage of study exploring how scientific controversy is presented in television, radio and digital media despite that broadcasting plays important role in science communication for low literate audience in developing countries and digital and social platform are highly appreciated for its longer-lived archives and easier access than the traditional newspapers (Farr et al. 2006, Locksley 2009, Ramalho et al. 2012, Shrestha et al. 2014). Ramalho et al. (2012) and Castelfranchi et al. (2013) are exceptional studies employing TV newscast as source for exploring science in the media. Yet the both studies merely focus on science novelty rather than controversial aspects of science issues. The overwhelming focus on print media is criticised because its incapacity to reflect the overall relevance of different media in science journalism in developed countries (Schafer 2010). However, it is argued that newspapers in the South could probably represent the media because print media have maintained their significant roles in mass communication in these countries despite the flourishing of electronic media since the beginning of the century (Wan IRFA 2019). Given that India experiences an increasing in newspapers circulation, a majority of India audience relies on newspapers for information (Patil 2011, Dutt 2012, Subudhi 2015). Similar increase of press readership Africa and the growing of newspaper circulation in Latin America (Bakker 2012, Plantinga 2012) differ developing countries' media from the overall decline of traditional newspapers in Western media.

Finally, regardless the diversity of conflicts in scientific controversies, literature shows that *a major trend of media coverage is benefit-focused on the new emergent science and technology*. For example, in a longitudinal research on the biotechnology representation in 12 European countries, Durant et al. (1998) indicate that European portrait of biotechnology is primarily positive, with heavy emphasis on scientific progress frame. There is scant coverage framing the story as risk-only

inversely. It is in agreement with later studies in the American media (Nisbet and Lewenstein 2002), Japanese media (Hibino and Nagata 2006), Dutch newspapers (Gutteling 2002) and Belgian popular press (Maesele and Schuurman 2008) that progress frames, benefits favour and positive tone are more widely contemplated than risks, notwithstanding evaluations of controversies are slightly different in each nation. In nanotechnology debate, existing studies find the majority of articles reflect nanotechnology positively and benefits is depicted as a preference to risks (Lewenstein et al. 2005, Stephens 2005, Leinonen and Kivisaari 2010). For example, Friedman and Egolf (2005, 2011) consistently show little coverage of risk on the US and UK media in the two periods 2000-2004 and 2000-2009. Nanotechnology is framed as a scientific innovation that can make potential revolutions to the development of economy, medicine, material and technologies.

Regarding developing countries, Du and Rachul (2012) and Lü (2009) find that media have tendency to support the functions and benefits of high technology without intensive understanding and critical evaluation. Masood (2005) provides more evidence to affirm the media are in favour of emerging science advancements that news about GMO in Kenya, Brazil and India tend to be on the side of its benefits. It coincides with a recent study by DeRosier et al. (2015) on Kenyan GMO crops and foods that the newspapers are templated to promote biotechnology advantages. This overexcitement to science interventions is also found in newspapers' exaggeration of the unproven stem cell treatment in China (Ogbogu et al. 2013). The Chinese media overwhelming support to this controversial and unforeseen clinical application because they are, according to the authors, affected by the industry's intention to shape the public perception of a Chinese promising destination for stem cell therapies. It is relevant with Reis's comparative studies on the Brazilian and North American newspapers framing stem cell controversy that media in the less developed countries are so supportive to medical positive facet that they usually amplify its safety and effectiveness by using powerful words, such as: dramatic, revolutionary, promising, incredible (Reis 2008). The positive tone of news stories in national and local newspapers is also evident in a large number of studies such as that of Navarro and Hautea (2011), Panopio and Navarro (2011), Du and Rachul (2012), Ramalho et al. (2012), Castelfranchi et al. (2013), Midttun et al. (2015).

4.4. Research into the production of global scientific controversies in the media

In contrast to a substantial amount of studies on the media coverage of scientific controversies, there has been less attention paid to how such issues are selected and framed, by what motivations, in what social contexts and influenced by what factors and actors. Accordingly, the discussion on the production of global scientific controversies in the media is not as intensive as empirical research on the science coverage. Since several authors occasionally observed the journalists' practice, media routines and norms, it is virtually difficult to evaluate the nuance of controversial science news production.

A preliminary observation on the news production by Stocking (1999) and Dunwoody (1999) identify the indicators affecting journalists' intention to represent scientific uncertainty. In addition to individual characteristics (knowledge, experience, perception and motivation), journalism norms, institutional demands and national culture are further patterns regulating the news representation of science. Stocking (1999), in line with Fleck (1979) and Ebeling (2008) claims that in general, journalists usually misrepresent science by amplifying its certainty. Occasionally, they make it more uncertain than the scientific evidences prove it to be by focusing on contradiction without explanation. Uncertainty is also caused by equalising the arguments between scholars with different levels of expertise, and academics and lay public. Stocking and Holstein (2008) state that journalists may unwittingly quote contrary claims from trade association to strengthen the journalistic objectivity and profession. However, they are sometimes found to actively hype several aspects of uncertainty to attract public attention (Stocking 1999, Stocking and Holstein 2008). Although it gives the controversy equal accounts on both for and against sides, journalists are criticised for their false balancing. The simplification of objectivity eliminates journalists' analytical judgement and confuses the public about the scientific validity (Friedman et al. 1999).

Priest (2001) supports this assumption by analysing the case of cloning in the United States. The author argues that human cloning is not an intra-scientific controversy. Indeed, it is a created controversy between scientists and ethicists in which the latter's arguments are used to oppose the former's viewpoints to satisfy the US

“objective” tradition. In other words, journalists tend to balance the human-reproduction debate by seeking divergent views though visible disagreements about scientific facts are hardly acknowledged by the experts. In addition to intentionally treating ethical reasoning as equally as scientific fact, which is uncommon in the US mainstream media, US journalists probably use the “marginal” voices from fringe groups to balance the cloning stories. Although these points of view are not prominent in the media discourse, framing biotechnology as a controversy between science and non-science community could influence further coverage of biotechnology and distract public attention in the cloning debate. By discussing the scientific controversy production from the cultural viewpoints, institutional interests and journalism tradition, the author uncovers the journalism practice beyond the news. However, the analysis primarily grounds on an observation of US newspaper coverage of cloning rather than an exploratory investigation into the relationship between the influential actors and the journalists in the news production. Similar to Stocking (1999) and Stocking and Holstein (2008), Priest (2001) also misses the reasons for journalists’ tendency to strengthen or avoid uncertainty and employ whichever sources in their news framing.

The factors influencing the journalists’ intention and behaviours in science reporting are discussed in more recent studies (Guenther and Ruhrmann 2013, 2016, Guenther et al. 2015). While Guenther and Ruhrmann (2013) employs the gatekeeping theory to examine the journalism sourcing, Guenther et al. (2015), applies reasoned action approach (RAA) model to identify the indicators influencing journalists’ depiction of scientific uncertainty. However, both studies coincide that there are plenty of factors having impact on the journalists’ selection criteria and behaviours regarding how to represent degree of scientific uncertainty in German media. In terms of the selection principles, perception of professional role and personal concern on scientific issues are dominant individual elements determining the journalists’ performance. Further communication routines, such as the relevance and innovation of science, and organisational impacts including the support from colleagues and the editorial discussion, are important to science selection. For instance, researches show that despite journalists perceive more attention should be paid to the risk in nanotechnology depiction, their depiction varies according to the topic. No matter how they opt for uncertainty, journalists emphasising the benefits

are likely to represent certainty while those who mainly focus on risk tend to illustrate the uncertain aspects of nanotechnology. It shows a gap between journalists' intention and actual representation. They adopt different styles of scientific uncertainty coverage according to their behavioural, normative and control beliefs. These ideas are important for this thesis because they provide conceptual frameworks for understanding the journalists' awareness and practice. However, the prime focus on nanotech scale and technology may not standardise for the representation of scientific controversies in general. It may be further applied in a broader examination in relation to other influential levels, such as context of cultural differences.

Following this concept, Guenther and Ruhrmann (2016) conduct a survey to explore the journalists' intention to perform uncertainty in their reportage. The authors confirm a variety of factors facilitating the news practice. For example, journalists tend to mention uncertainty in their future reports as they are influenced by the coverage of other media. Moreover, awareness of scientific uncertainty in the main field of coverage, past behaviour and interest in public expectation prominently affect the likelihood of representing uncertain science. Especially, the results that male is more likely to depict uncertainty to female journalists reveals gender is one of the most influential predictors affecting science reporting. The findings could be satisfactory in analysing the motivation of journalists in representing nanotechnology controversy. Yet it cannot be used to generalise the perception of science journalists in other controversial topics. Furthermore, the examination is based on journalistic self-assessments of professional behavioural patterns. The assumption about how other actors involved in the process of news production, such as politicians, public relation officials, industrial workers and non-governmental actors influencing journalists could not be generalized from this finding.

In terms of such influential actors, evidence shows academic organisations, science publishers, political parties, commercial entities or activist groups set the media agenda and make science prominent in the news (Priest 2001). Ebeling (2008) indicates that the most priority role of PR is setting the public agenda for their personal interests. In the case of nanotechnology, PR officials attempt to manage the public perception of the scientific benefits by making the issue more certain.

However, as discussed above, this influence varies among science journalists because they concern and convey such information differently, depending on their personal interests, perceptions of the audience, individual understanding of science and journalists' mission (Stocking and Holstein 2008). For example, disseminator journalists tend to downplay the uncertainty by simply transferring the information from the business agent to the audience while the populist mobilizer journalists prefer lay opinion to experts and commerce; the adversarial reporters are likely to overestimate uncertainty by ignoring scientific evidence and strengthening industrial sources; conversely, those act as investigative journalists are more sceptic in using industrial claims. In terms of developing countries, there is some evidence that politicians, activists, governmental and non-governmental groups have even more significant impacts on the news production (Arujanan 2011, Kwenda 2013). Nevertheless, research on the influential actors is primarily media orientated. There is lack of empirical studies of voices outside the newsroom, in both organisational and individual levels, to provide a comprehensive evaluation of how they affect scientific controversy production. The present research further develops the initial conclusion of these earlier studies by exploring the relationship between the influential stakeholders and journalists as well as the news outlets in the production of global scientific controversies.

4.5. Concluding notes

The above studies highlight a number of aspects in the media representation of scientific controversies. First, a substantial amount of empirical work examining the media coverage of scientific issues exists but much of the analysis is primarily based on content analysis to identify the intensity and nature of a particular scientific controversy in the media. In comparison, there are fewer studies that function to explore the complexity of the controversial science news production. In tandem with the focus on science content, research on media representation of global scientific controversies is media-centric bias through taking inner newsroom approach. It is still unclear how different science actors stand in the case of scientific controversies and how their influences facilitate the coverage of controversial science in terms of frame, source, risk and benefit, tone and evaluation. Additionally, controversy is primarily mentioned as an aspect in studies of science media (Nisbet and

Lewenstein 2002, Friedman and Egolf 2005, Mellor et al. 2011) or an instrument to identify the uncertainty (Durant et al. 1998). It is not yet employed as a core concept to understand the prolonged scientific disputes in the public sphere. Moreover, under the constraints of globalisation, to what extent and which strategies newsrooms and influential actors employ to localise global controversies is a further open empirical question. The next chapters will provide more intensive understanding of how global science controversies are perceived, framed and localised by Vietnamese journalists. Employing the two cases studies: genetically modified organism – a prolonged global issue that attracts a substantial media attention and artificial intelligence – an emergent technology that its promising benefits and unforeseen risks are challenging every state across the world, the following parts of this thesis aim to explore the role and function of media in presenting and shaping public understanding of global science controversies and their implications for the development of Global South.

Chapter 5

CASE STUDY 1: VIETNAMESE NEWS REPORTING OF CONTROVERSIES OVER GENETICALLY MODIFIED ORGANISMS

As one of the most scientific controversial issues, genetically modification (GM) has attracted a substantial public attention and a considerable media coverage since the turn of 21st century. The innovative technology, which was developed in 1970s, is a process in which a selected individual living material is transferred from one organism into another, particularly among nonrelated general (Okafor and Okafor 2017). This chapter uses GMO as a case study to assess the professionalism of science journalism in Vietnam and evaluate the degree to which it fulfils its critical role for national development.

Although there is hardly any evidence about the negative effects of genetic engineering on human health and natural environment, over the last decades, global public have taken a sceptical viewpoint towards GM products. According to a survey in 2015 by Pew Research Centre, nearly ninety percent of *American Association for the Advancement of Science* scientists *were on the GMO's side while only one third of the US ordinary citizens shared the belief (PEW 2015)*. *The global public has kept their doubt over GM foods' safety to humans, environments, social and ethical norms: 48% of participants in a recent PEW international survey said that they believed food contained GM ingredients are unsafe to eat while only 13% of that think GMO is good and harmless (Funk et al. 2020)*. There are further concerns on its influential force to socio-economic sustainable development, particularly between the GMO exporters and importers, developed and developing nations. The disputes over the prospect and consequence of GMO involves various stakeholders, ranging from scholar community, farmers, food buyers, biotechnology corporations, governmental agencies, non-governmental groups and activists. The public doubt in GMO effect is not restrained in certain regions but widespread across the globe (Ruan et al. 2019). While GMO is widely accepted in the US and several parts of Asia, in some countries, particularly the EU, the debate turned out to rally and march for GMO restrictive regulation or legal activism and contest against international GMO commercial trading (Sheldon 2002, Ruan et al. 2019). Generally, *GMO controversy appears to be more than a public fear of GM adverse effects on human beings. It is a created controversy, driven by the concern over GM social, economic, ethical and developmental costs (National Academies of Science Engineering and*

Medicine 2016). The political, legal and cultural differences among countries across the globe also make GMO one of the prolonged scientific controversy of the late twentieth and the early twenty-first centuries, which over the extent and effect involves various stakeholders, i.e. scientific community, farmers, customers, biotechnology corporations, to governmental institutions, , non-governmental groups and environmental activists.

While GMO is integrating into every aspect of our daily life, studies reveal that the public often lack understanding of and experience with GM technology. They rarely gain GMO-related knowledge from academic platforms, such as education or scientific journals, but merely from the media (Scheufele and Tewksbury 2007). Therefore, it is significantly vital for mainstream media to interpret and deliver GMO updates as well its long-term consequences to the public. While science journalism alone is unable to fulfil all science communication functions, few other channels would be able to match its widespread reach and influence. For developing countries, a strong base on critical science journalism would be more crucial as these countries merely adopt science and technology from the more advanced countries rather than producing end of S&T. Any false choice of either excessive reliance on GMO as a panacea for all eco-agricultural issues, or aggressive opposition to GM foods and crops for its unintended limitations can be at the expense for development. The Zambia government's rejection to GM food aids despite of the national extreme hunger crisis in 2002 is a typical example of how challenging developing countries are facing to grasp, monitor and control scientific controversies. In this context, an informed and critical science journalism would assist the less scientifically advanced countries to progress and grow in that respect. Otherwise, biased news reporting, might shape public impartial perception of and irrational choice towards S&T (Nisbet and Lewenstein 2002, Holliman 2004). Particularly, the news media focus on technological risks has potential to strongly influence public risk perception (Sarathchandra and McCright 2017). The Zambia case study suggests that critical science journalism is of significant importance for developing countries to be well informed, and rationally engaged with the GM development into their daily socio-cultural, economic and political life. In countries like China, Philippines and Vietnam, governments consider agricultural biotechnology as an effective means to foster the national economic growth and

enhance the country's competitiveness. Although these nations are directly involved in GM technological chain, they are almost often absent in the international GMO debates (Rodriguez and Lee 2016). The dearth of studies in the media coverage of GMO in developing countries proposes a gap for a throughout understanding of the GM debate and its potential influence on policy maker and citizen in a developing country context. This study, thus, employs Vietnam as a case in point to explore to which extent science journalism in a particular developing country fulfils the roles it upholds for developmental goals. By exploring which salient topics, frames and sources are employed by the local news media to frame public understanding of GM technology, the chapter seeks to provide detailed insights into the state of science journalism in Vietnam through a case analysis, as well as to contribute to the literature on how global science controversies change their status across cultures and contexts. In doing so, this chapter helps to examine the relationship between scientific and technological innovations, political and economic considerations, and sustainable development.

5.1. A review of genetically modified organism (GMO)

5.1.1. *The GMO controversies*

According to World Health Organisation, genetically modified organisms refer to organisms, such as plant, animal or microorganism containing genetic material (DNA) which has been altered by genetic engineering or transgenic technology instead of natural recombination (WHO 2014). Through the transferring of selected individual living material from one organism into another, particularly among nonrelated genera, GM technology modifies the original species to create new plant, animal, bacterial and virus genes that do not exist naturally, purposely enhancing the quality of such organisms for certain interests (Okafor and Okafor 2017). While genetically modified animals are almost employed in medical and pharmaceutical research and applications, genetically modified plants are more common used to enhance the today's food quality. Foods contained GM organisms are labelled as GM foods.

In contrast to the traditional crossbreeding technique which transmit genes only among the same species, modern genetic modification goes beyond the intervention

breeding barrier, transferring genes only within the same species but also between unrelated species to create a new genetically modified organism. Although its embryonic signals sprouted in the early time of DNA, modern genetic engineering research was established by Herbert Boyer and Stanley Cohen in 1973 (Lu 2017, FDA 2020). By merging DNA from one bacterium that can resist the antibiotic kanamycin, into other bacteria, the biochemists created a new bacterium that remain alive regardless the kanamycin attach. Boyer and colleagues then found the first genetic engineering company. Their human insulin product for diabetes treatment, generated from E.coli bacteria, was introduced in 1978, and it eventually was approved to be the first biotechnology product in the market by the US Food and Drugs Administration (FDA) in 1982 (Lu 2017, FDA 2020). The earliest genetically modified plant, an antibiotic-resistance tobacco variety, was introduced in 1983 (Van Montagu and Burssens 2000). In 1988, virus-resistant tobacco crops were planted in China, marking China the pioneer country in the globe approving commercial genetic plants (Tao and Shudong 2003).

Since then, the Chinese government has continuously run biotechnology research programmes, i.e. The National High-Tech R&D Program, The National Basic Research Program of China and transgenic technology research programs to support its GM development (Du and Rachul 2012), aiming to make China “dominate the high points of GMO techniques”, as President Xi declared (Chow 2019). According to Tao and Sudong (2003), until 2003, there were more than a hundred biotechnology labs across China, focusing on searching and brining GMO innovations to production and training biotechnologists. Thanks to these programmes, China has achieved significant progress in agricultural technology. For example, the success of bt cotton has made China, along with India, one of the leading GM cotton producers worldwide (Statista 2020). In the US, a GMO tomato named Flavr Savr was the first agricultural product commercially approved in 1994, after its safety was proved equivalently to tradition bred tomatoes (FDA 2020). The 1990s also recorded GMO commercialisation in the US with many GM plants introduced to the public, including summer squash, soybeans, cotton, corn, papayas, tomatoes, potatoes, and canola (FDA 2020). At this time, European countries were not as strict to GMO as today. As in the US, European first commercial transgenic organism crop, a GM tobacco, was endorsed in 1994 (Mackenzie 1994). However,

the EU legal regime on GMO has been more severe since 2001 as a result of the EU moratorium, certifying a GMO food can only be available in the market if it complies with the EU risk assessment to health and environment (Damien and Guy 2020).

While GM technology has long attracted public and state attention in the US, EU and some parts of Asia, such as Japan and India, and Africa such as Nigeria and Zambia, it has yet been a controversial issue in the other developing parts of the world such as Vietnam, Myanmar or Philippines. Since these areas often lack capacity and resource to evaluate GMO, in 2003, WHO and the Food and Agriculture Organisation (FAO) released a Codex guideline for GMO in the developing and transition nations to prevent their agricultural diversity from the GM's negative impacts. Despite the dispute around its worth and cost, modern genetic engineering is one of the fastest-growing technological innovations that many countries prioritise as strategic force for development. The US has approved a plenty of genetically engineered foods, such as apple and salmon (FDA 2020). It now comes first in the list of nations having largest GM crops worldwide, followed by Brazil and Argentina (Statista 2020). The latest achievement in GM called genome editing, a branch of genetic engineering which makes changes to the DNA of an organism to create new varieties of plants, animals and bacteria. While it brings huge benefits to human development, gene editing also raises serious concern about its consequences. The CRISPR baby scandal that Chinese biotechnologist He Jiankui produces genetically edited twin girls was a "bombshell" of human evolution, awakening public awareness about the perils of advanced genetic technologies (Cyranoski 2019).

The debate about GMO dilemmas, indeed, has never ceased since the early time of recombinant DNA research (Torgersen 2004). The fast-moving development of biotechnology has led to a prolonged and smouldering public dispute about its social, ethical and political consequences without any conclusion so far. While the initial concerns mostly focus on the potential threats of GM in general, the latter disputes centre at the risks of GM foods and plants. Further, in the early time, controversy is primarily about scientific evidence. However, in the latter period, the debate is shifted to political and ethical controversy between various GMO stakeholders (Holliman 2004, Hibino and Nagata 2006). Although recent reports highlight a general

consensus among biotechnologists about GMO's safety, the disagreements about the GM long-term consequences on human beings has yet over (FAO 2003, National Academy of Sciences 2017, Normile 2019, Funk et al. 2020). Rather than a pure scientific dispute, GMO becomes a mixed controversy that is intentionally created by particular groups for financial, political interests and ideological, religious values. The GMO advocates, such as biotechnology corporations and pro-GMO politicians argue that GM crops help increasing yields, improving the food value, lessening the use of agricultural chemicals, limiting the farmers' insecticide exposure, and as a result, it can boost the crops production and solve global problems of food security. The critics, such as environment activists, non-GMO food companies and lay public, often raise concerns on the safety as well as the possible effect of GM foods for long-term use. The GM opponents also question about the actual impact of GM crops on environment, whether GM could cease or increase the herbicide- and pesticide-resistant weeds and insects. Anti-GMO groups claims that the excessive dependence on huge biotechnological corporations for GM seeds would threaten traditional farming practice, mitigating small scale farmer's competitive capacity in the commercial agriculture. The extent of GMO controversies was also varied due to different legal regulations, political regime, cultural circumstance and religious hierarchy. These dilemmatic issues make GMO an everlasting polarised debate of our current time.

In contrast to the significant development of biotechnology as well as the continual dispute over GMO across the globe, research shows that the public worldwide have limited knowledge about GMO (Wunderlich and Gatto 2015). These authors found from the literature that more than half of US citizens in a survey are unfamiliar with GMO while only a small number of US adults are aware of GMO ingredients in their daily foods. Yet American consumers still have better understanding of GMO than Italian and Japanese. The Chinese have also been found to lack basic knowledge and awareness of GMO safety (Cui and Shoemaker 2018). In a more recent and longitudinal study, Zhao et al. (2019) reveal that 60% of Chinese public are unaware of the GM products they are usually consuming. Despite their different time frames of research, both studies find that people more familiar with GMO tend to accept GM foods whereas those who have limited understanding of GMO are more averse to GM products. However, both proponents and opponents are yet to fully perceive the

potentials and consequences of GMO. The poor knowledge and misunderstanding of GMO benefits and risks might lead public to irrational decisions about GMO acceptance or ignorance. Thus, the news media, as an important means of science communication, play a very vital role to provide accurate and balance information to consumers, to alert the policy makers about GM implications and preparing every lay person in the GMO contest. The media, however, are not yet successful in their role. A number of studies on the media coverage of GMO will be analysed in the next section to establish an overview of how media shape public understanding of GM technology.

5.1.2. Research on media coverage of GMO

Since the first GM plant was commercialised in 1990s, GM technology has remained a highly controversial topic in social sphere. The widespread public debate on GMO social, economic, ethical and political implications has prompted many researchers into examining media coverage, public perception and regulation of GMO (Durant et al. 1998, Bauer and Gaskell 2002, Kohring and Matthes 2002). It is well documented that scholars in the US and Western Europe have given a considerable attention to media coverage of GMO during the last twenty years (Kohring and Matthes 2002, Cook et al. 2006, Crawley 2007, Kehagia and Chrysochou 2007, Marks et al. 2007, Augoustinos et al. 2010). On the other hand, there were far and few studies on the Asia, Africa, Latin America and other parts of Europe (Chong et al. 2004, Outram 2010, Du and Rachul 2012), despite the critical role that media play for their national strategy towards this new and complex technology.

Further, researchers across the globe mostly relied on content analysis to explore the trend and themes of GMO controversies in the news (Bauer and Gaskell 2002, Priest and Ten Ecyk 2003, Nisbet and Huges 2006, Ogbogu et al. 2013, Rodriguez and Lee 2016). While quantitative content analysis is powerful to identify the frequency and frame categorisation over selected periods of time, it is unable to provide in-depth interpretation of how GMO is narrated, illustrated and metaphorized in the media. Therefore, in addition to content analysis, discourse analysis has been used in a handful of studies to analyse the message underneath linguistic cover within its social context (Cook et al. 2006, Augoustinos et al. 2010, Maesele 2013). For example, Cook et al. (2006) combined corpus linguistic and critical discourse

analysis to identify the British newspaper's different approach to GM foods. The method was used in another study by Augoustinos et al. (2010) to analyse the political "battleground" between the British public, the British government, the scientific community, and the biotechnology companies. While discourse analysis was found as an effective tool to unveil how various perspectives towards GM technology are presented in polemical context, Maesele (2013) used critical discourse analysis to explore the ideological conflicts in four case studies about GMO crops and foods in two Belgian prestige newspapers. In addition to identifying the predominant frames used to construct the content, critical discourse analysis allowed conclusion about the meaning, the values and the contextual culture such frames represented. The advantage but inferior status of discourse analysis to content analysis suggests a combination of the two methods for more thorough studies GMO news coverage.

Along with the dominance of content analysis, research on GMO and media is overwhelmed by print newspaper. Radio and television, which have great contribution to public knowledge and attitude towards science and technology, are rarely discussed in associated with GMO (Bauer and Gaskell 2002, Karembu et al. 2009). Nucci and Kubey (2007) studying GM foods in the US national evening news was among few studies on how GMO was constructed in the broadcasting media. As opposed to their high performance in the print dailies, GM events and issues were not of US television's significant interest. Apart the peaks with irregular GM events, the three channels CBS, NBC and ABC in Nucci and Kubey' study (2007) showed minimal and uneven coverage of GM food issues during 23 examined years. The paucity of literature on television coverage of GMO over the course of their development, despite their vital role for science popularisation, is in opposition to the rising scholarly attention to the relationship between GMO and social news media. Due to the rapid development of media content in digital platform, GMO media scholars have recently moved their research interest from the traditional media to social media. Particularly, most research so far focused on China, a typical emerging country in the South (Kim et al. 2014, Wen and Wei 2018, Xu et al. 2018, Zhou et al. 2019, Wang and Song 2020). According to Xu et al. (2018), online news and social media were more effective in attracting public attention and involving users' interaction in science forums. While Chinese public merely depend on mainstream

news as source of information but tend to mistrust in the heavily censored media, social portal becomes significantly powerful in informing and engaging public in the GMO discussions (Wen and Wei 2018). Weibo is a typical social network successfully serving as public forum for GMO debate, fostering citizen participation in controversial socio-scientific issues and promoting democratic culture in a highly authoritarian like China (Wang and Song 2020). Online webpages and social networks are also effective communication channels non-governmental organisations in the old continent employ to sustain their battle against GMOs (Garces 2006). Although along with legacy media, social media functions as an important platform for science knowledge diffusion, it is restricted in several authoritarian countries (Mueller-Herbst et al. 2020). Preliminary research into the social media coverage of GMO provide a glance into how social media supplement mainstream media which are struggling with the science desk cutting down in making public well informed about and actively engaged in important science policy. However, there is in need for more evidence of how GMO is framed in the digital and social channels and to which extent the online avenue succeeds in maintaining the critical role of media in science communication.

5.1.3. Reporting GMO – a “battle-word” in the media

Despite the limited understanding of media reporting GMO in developing countries, the existing literature as a whole shows a polarised media representation of GM debates.

First, research shows a considerable media attention to biotechnology and GMO in the North, where the intensive debate over GMO has lasted to date. Excluding Greece, there was a gradual rising media coverage of GM foods and crops in Europe since 1989 (Bauer and Gaskell 2002). Biotechnology continuously maintained its high profile in British newsrooms after 1991 despite a sharp jump in the press coverage after 1997 (Bauer and Gaskell 2002). A similar upward trend was found in the US (Nisbet and Lewenstein 2002) and Japan (Hibino and Nagata 2006) during the 1980s and 1990s. The number of articles about biotechnology in these countries consistently rode high after the turning points 1996 and 1997 as a result of the public debate over Dolly announcement and Monsanto’s soya imported into Europe (Bauer and Gaskell 2002, Nisbet and Lewenstein 2002, Hibino and Nagata

2006). Castro and Gomes (2005) suggested the media explosion to GM coverage may stem from the increasing interference of NGOs, who kindled for debate, to biotechnology safety in GM forums. The overall increase press coverage of biotechnology identified in European, US and Japanese national elite press between 1992 and 1999 was reinforced in Belgium local newspapers after 2000. However, the peak found in Belgium popular press was latter than other European countries, because it was derived from the media rush for the first cloning baby Eva by Italian scientist Antinori and American scientist Zavos (Maesele and Schuurman 2008). The common denominator of these zeniths in EU and US media was the peaks are often concurrent with remarkable GMO events or issues (Geary et al. 2016).

Of the 26 countries that planted biotech crops in 2018, 20 were developing countries. Among 18 global biotech mega countries were 14 from the developing world¹¹. However, in contrast to the developed countries, these countries showed insufficient media efforts to inform public about GMO (Karembu et al. 2011, Lore 2011, Omeje 2019). For instance, substantial research in Africa reveals the media failure to provide public with good information for their GMO debate and decision making (Karembu et al. 2011, Lore 2011). Most of publications about GMO in Kenya were found during the public discussion of Kenyan ban on GMO food and Seralini report in 2012 (Ligami 2016). Similarly, despite biotechnological agriculture has direct impact on farmers, GMO was not a favourite topic in the Nigerian media (Olajide and Fawole 2015). The low number of daily news coverage, according to Omeje (2019), was because of unprofessionalism in science journalism in Nigeria. Due to their lack of journalistic skills and supplementary materials to cover science controversy, journalists in Nigeria tended to ignore GMO stories. In Zambia, only four newspaper articles voiced up the GMO issue throughout 2000 even though the country's rejection to GM-maize aid from the US caused intensive social controversies about GM safety (Fackson 2002). In China, despite the evolution of GMO debate, especially among the netizen, the topic was not a prominent issue in mainstream media (Wen and Wei 2018, Li et al. 2019). During the period of 2002-2011, the two leading elite Chinese press, People's Daily and Guangming Daily, published less than eight articles about GMO per year (Du and Rachul 2012). Vermeer and Ho (2004) ascribed the absence of GMO in the news to the governmental influence on

¹¹ <https://www.isaaa.org/resources/publications/pocketk/16/>

Chinese media. It is therefore over 80% respondents of their 1000-participant survey lacked knowledge or misunderstood of transgenic products while only 20% urban consumers showed a limited awareness of GM foods and crops.

Similar observation was found in Philippine newspapers with a small number of articles covering GMO. Particularly, most of the news about GM foods and golden rice were published in the national elite dailies while regional and local newspapers pay scant interest to the issue (Mula 2007). The volume of GMO news, like the Western media, occasionally peaked in concurrence with remarkable events which attracted high public attention, such as the approval of commercial bt maize crops, the official allowance of planting GM seeds on private peasant's land. Yet the flashpoint period was unable to sustain intensity, GMO still received modest media attention compared to other politic and economic topics (Panopio and Navarro 2011). Apart Philippines, GM foods and crops have not yet been critical concerns in other parts of Southeast Asia (Asoro 2012). Mainstream media in Cambodia, Vietnam, Malaysia, Indonesia demonstrated a minimal attention to genetic engineering and biotechnological products. Even Thailand, which had highest interest to the topic, the media published less than 25 articles about GMO each year of the period 1999 – 2011 (Asoro 2012). It suggests that during the first decade of the 2000s, when GM technology was officially exported from the more advanced biotechnology countries to the developing countries, it was not a prominent issue in the media agenda.

The literature also shows a polarity in the media attitude towards applications of genetic engineering in agriculture and medicine (Bauer 2002, Marks et al. 2007). Data extracted from a longitudinal analysis of British press manifested an overall media support to bio-medical applications of GMO. Inversely, the study presents a dispute over the potential danger of GMO food and crop (Bauer 2002). A comparative study on the UK and US news media also found a similar dichotomous media reaction to the two sets of technologies. While agricultural genetic engineering was often framed as negative and controversial issue, journalists yielded a strong promotion of the benefit and prospect of GM bio-medical application (Marks et al. 2007). Even though there has not yet scientific evidence on the risk of GMO crop and food, media in the two countries tended to emphasise the consequence of

agricultural GM more heavily than medical GM. Especially, Botelho and Kurtz (2008) find the media coverage of GM agri-foods in both UK and US was event-driven with the peak attention often focused on highly negative events. However, the intensity of risk coverage in the UK was heavier than those in the American newspapers (Botelho and Kurtz 2008).

Although agricultural GM was framed more negatively than medical GM, media coverage of GMO foods and crops was not homogeneously negative across the globe. While the Eurobarometer study (Durant et al. 1998) revealed a consistently benefit domination and progress frame favour in media coverage of biotechnology across the Europe, the GMO's portrait varied in each country. In terms of national difference, Denmark and Switzerland were found to raise more concern on risk and ethic. Austria, conversely, gave more balance to GM prospect and consequence along with middle-range progress framing, but it had the highest level of moral emphasis among the European countries. Bauer and Gaskell (2002) confirmed the diversity of GMO news representation in fourteen European countries, specifying such differences in terms of intensity, themes, actors as well as overall tone of coverage. Media representation of GMO was divergent partly because of the distinct economic condition, social hierarchy and political context of each country. For example, in several highly authoritarian Asian states which favoured GMO, such as Philippines, China, Vietnam, newspapers largely supported GM food and plant. Mainstream media in these countries often framed GMO as an effective tool for national development with the domination of governmental source (Navarro and Villena 2004, Navarro and Hautea 2011, Asoro 2012, Du and Rachul 2012). Across African continent, while Kenyan news reporting was found to contain more benefit than risk frames (DeRosier et al. 2015), Nigerian and Ghanaian newspapers were overwhelmingly negative of genetic engineering and its products (Zamith et al. 2012, Omeje 2019). Rodriguez and Lee (2016) suggested that the domination of hazard content potentially leads to or reinforce public uncritical opposition to GMO research and products. Indeed, the bias media coverage had influential impact on policy making process, i.e. increasing the Ghanaian public unwilling to support GM research fund and fostering Zambia government refuse GM maize aid (Mumba 2007, Rodriguez and Lee 2016).

Sometimes, the media attitudes to GMO is affected by political tendency of each newspaper. For example, Cook et al. (2006) found that British newspapers had different approach to GM foods. While several common discourses focusing on “anxiety”, “concern” and “worry” dominated *The Guardian* and *Daily Mail* which merely opposed to GMO, “irrational”, “unscientific”, “anti-science” phrases were often used by *The Times* and *The Sun* to criticize the GM food opponents. However, both anti and pro-GM newspapers consistently demonstrated GM food debate in the UK as a competition among different interest groups. This finding suggests that instead a pure scientific controversy, GMO is rather a mix-controversy which is governed by different vested groups. The British national debate on GM is indeed a political “battleground” between the British public, the British government, the scientific community, and the biotechnology companies. Particularly, the public was consistently portrayed as GM opponents, in direct contrast to the representation of British government’s support to GM crops and foods.

5.2. GMO in Vietnam – prospects and challenges

Vietnam is an agricultural country with 27.2 hectares of cultivation, contributing 82.37 percent of total nation’s natural area and 87.99 percent of used land¹². Of the population in 2019 of 96.2 million, 65.6 percent live in rural areas¹³. Agriculture, forestry and fishing take 14.68 percent and 13.96 percent of Vietnamese GDP in 2018 and 2019, respectively while approximately 39.45 percent of the national employers are working in agricultural sector (Statista 2020). In view of agriculture’s significant role for the national reconstruction and development, Vietnamese government has given high priority to policy fostering agriculture productivity. The central state has identified science and technology, with particular preference to GM technology, as a leading force for agricultural sustainable development. According to Ngo (2003), soon after GMO is introduced in Vietnam, the government releases Decree No.18/CP in 1994 declaring the country’s foremost priority to biotechnology research. Bioengineering is considered as a fundamental tool for national food security, health care development, and sustainable eco-system. In order to support the national biotechnology enactment, a National Commission on Biotechnology, led by MOSTE, was founded in 1997. In addition to assisting the Prime Minister, the

¹² <http://baochinhphu.vn/Xa-hoi/Cong-bo-ket-qua-thong-ke-dien-tich-dat-dai-nam-2018/379904.vgp>

¹³ <http://www.molisa.gov.vn/Pages/tintuc/chitiet.aspx?tintucID=29769>

interdisciplinary committee responds for GM research funding and management. In 2006, the Prime Minister signed Decree No. 11/2006/11/2006/ND-TTg, “Key program for the Development and Application of Biotechnology in Agriculture and Rural Development up to 2020” (Pham 2018). As a result of these early supportive policies, Vietnam is now one of the nineteen biotech mega countries with 0.1 million hectares of bt maize (ISAAA 2019). Biotech corn is also the only GM variety currently approved for wide planting in Vietnam. However, Vietnam imports a wide range of GMO products, particularly GM soya and cotton (Pham et al. 2018). Although setting GMO as a focal point for development, the government is aware of its potential consequences. In 2007, the Prime Minister continuously issued Decision No. 14/2007/QD-TTg and Decision No. 79/2007/QD-TTg specifying the action plan for biological development and management by 2020 (Pham 2018). The schemes mark the government’s turning point of encouraging GM research and production but ensuring GM commercialism taken safely and legally. In 2010, Decree 69/2010/ND-CP was released to provide a legitimate mechanism for the biosafety implementation and management, establish a legal framework for GMO risk assessment. The Decree was then amended and updated to Decree 123/2018 which stating a number of regulations for GMO import, export and production. Particularly, GMO products for animal feeding are only approved to imported, produced and sold in Vietnam if it acquires the biosafety certificate.

While the government has carried on initial actions to ensure the safety and efficiency of GM application in Vietnam, GMO is still a silent issue in the public sphere. Although a survey about Vietnamese public perception and attitudes towards biotechnology reveals a high interest and concern and moderate understanding among stakeholders, the examination primarily focuses on a more well-off part of the public, i.e. university scientist, policy maker, journalist, farmer leader and community leader (Le and Navarro 2011). Participants representing “GM consumers” in the survey are those urban citizens who tend to be middle-class and obtain at least college education. The lay community is inversely absent in the examination. In contrast, Vu et al. (2004) find that Vietnamese citizen have very poor understanding of and limited interest in GMO knowledge. Despite of the current existence of GM plants in the farm, GM cotton in textile industry and GM foods in the supermarkets, consumers are not aware of GM available products in their daily life. GM seeds,

crops and foods are unfamiliar for most of the wider public.

In 2010, Vietnamese Ministry of Agriculture and Rural Development (MARD) officially approved Monsanto, the US-original agrochemical bio-agricultural corporation – known as the manufacturer of Agent Orange used in the Vietnam War¹⁴ that causes four hundred thousand deaths, millions of dioxin victims and more than sixty thousand square kilometres of contaminated land in Vietnam – to take trial bt maize crops in Hung Yen Province (Le and Navarro 2011). Monsanto's return was welcomed regardless its dark past in Vietnam as well as the public concern on GMO's long-term impacts. Several anti-GMO activists' opposing voices were raised but too sporadic to attract widespread attention. Most of time, the media introduce GMO as a significant tool to foster the national economy, modernise Vietnam and make the country a leading economy in the Asia (Le and Navarro 2011). Along with mainstream newspapers, the government undertook communication strategy to promote public understanding of biotechnology for the “development of human society in general and to the development of agriculture in particular” (Decision No.11/2006). Several workshops were organised by MARD to seek ways to improve public awareness of GMO benefits (Hoang Anh 2014). The state general support along with media discourse of GMO's promising benefits appear to set public naïve perception towards GM technology. Thus, it demands for more comprehensive studies exploring the role of media in reporting GM technology as well seeking for potential initiatives to improve the GM coverage and provide public with definite information and expand their active participation in controversial science policy. As there are limited published reports about Vietnamese news representation of GMO, it is important to uncover the media practice in Vietnam in informing the country of the benefits and risks of utilising GMO to meet the country development demand.

In that context, this rest of this chapter will explore whether Vietnamese media serve the public well with their GMO reporting and guidance. The key research question, which is developed from the **RQ3 “How are global science controversies represented in Vietnamese news media?”** is:

RQ3a: How are the socio-economic and ethical risks and benefits of Genetic Modified Organism properly represented in Vietnamese news media?

¹⁴ Or *Vietnamese People's resistance War Against America* - the official term used by Vietnam

- *Sub-RQ3a1: How prevalent are GMO issues and events in Vietnamese media?*
- *Sub-RQ3a2: How are GMO issues and events selected, framed, sourced, and evaluated in Vietnamese media?*

5.3. Methods for this chapter

In order to answer the research question, thematic content analysis was employed to identify, quantify and analyse the presence, meanings and relationships among patterns in news story about GMO. The characteristics of GMO news interpreted from the content analysis were then analysed in relation with data about science journalists' profession and practice (which gained in the qualitative interview). By exploring the media representation of GMO from both content and production, particularly from the viewpoint of science reporters, the study would provide a more comprehensive insight about the GMO communication process.

To assess the coverage of GMO in Vietnamese media, we employed Google News database to search for GMO articles from 1/1/2017 to 31/12/2018, using simple Boolean keywords: “biến đổi gen” (genetically modified organism), “chỉnh gen” (genome editing), “chuyển gen” (genetic transformation), and GMO (acronym of genetically modified organism). Although Google News is criticised for several limitations, it is considered an appropriate search engine for Vietnamese news.

In order to limit the potential false data caused by using the researcher's personal computer on single web explorer, the author carried out a pilot data collection to examine whether algorithm based on users' online behaviours affect the search results. A set of ten computer devices, including laptops, desktops and tablets that run different operational system, e.g. IOS and Microsoft and different type of search engines, e.g. Safari, Firefox, Chrome, Cốc Cốc (a Vietnamese web portal) were hired for the pilot test. The examination was undertaken independently, at separate time-points, aiming to avoid any possible difference caused by timeframe. The news articles scrapped by those ten devices showed almost the same number and order

of search results across the different time-points (See Appendix 2). Thus, the sample collected from the researcher's computer could be seen as reliable for this analysis.

In spite of several advantages, compared to print archives or academic electronic databases, there are several criticisms about the misuse and manipulation of data provided by Google News (Duhigg 2018, Gilbert 2019). In order to minimise the bias and ensure the transparency of data, we contacted Google Support and Google News Press to ask questions on how Google News' algorithm operates, and what specific criteria Google uses for their news selection and delivery. Despite our effort, there was no response from Google Press. We then tried to reach a Google agent who responds for Google News Lab in the United Kingdom. Due to the sensitivities around revealing the operation of the algorithm, the best he could do was to redirect us towards Google Press, which had formerly ignored our query (See Appendix 3).

Regardless of such limitations, as there is no Vietnamese database equivalent to LexisNexis, Proquest or EBSCO, Google News is considered as the most appropriate search engine for our news collection. Furthermore, Google search, which has several advantages compared to traditional news archive, such as wire news inclusion, original version of news stories storage, would also provide more comprehensive samples than particular newspapers which are unable to represent the national media (Weaver and Bimber 2008). Notably, as most Vietnamese print news stories are re-posted on their digital platforms, stories collected from the digital search engine could stand for not only online but also print media throughout the country.

In general, using Google News and keyword searching technique, the study collected 439 stories about GMO. After deducting duplicated articles, our research came up with a total number of 401 pieces of GMO articles for the full analysis.

Each news article was treated as one unit of analysis. A coding instrument was developed by adopting fundamental variables, such as themes, frames, sources from previous studies (Bauer et al. 1995, Durant et al. 1998, Nisbet and Lewenstein 2002). In general, each story was analysed using a systematic coding procedure, which consists of three parts (See Appendix 5):

(1) news article meta-data, including the publication details, such as name of publication, month and year of publication, length of publication, type of publication;

(2) prime characteristics of the story, including the author, headline, sub-headline, lead, placement, section, and illustration (these variables will be coded on nominal scales by choosing one or multiple variables for each category); and

(3) news narration elements, including topics, themes, genres, type of coverage (episodic/ thematic), controversy, consequences (risk and benefit), frames, localisation, source, metaphor, evaluation, solution and scientific progress.

In addition to variables describing the meta-data attributes of the sampled articles, the study employed categorial variables to measure the thematic content and narrative patterns of news stories. The coding units were systematically coded for following narrative elements:

Topic: A topic explains what a story is about. News article topic is a discussed issue or event that provides message content. It clarifies the main focus of the news article. Depending on what main type of science mentioned in the story (such as GMO plant, GMO food, GMO application in health and medical treatment; Others or Unclear), the coders chose one among the pre-defined topics occupied in the article.

Theme: A theme is a cluster of message properties of a topic. It is the central idea implied in the text that the writers want to convey. Although an article may be solely concerned with one theme or several themes, the study chose only the primary theme. Originally, it was classified along the following categories: “New scientific research”, “Scientific research process”, “Applications and implications”, “Policy and legislation”, “Trading and industry”, “Scientific debate”, “Public perception” and “Others or Unclear”. During the coding, several themes were infrequently found. Thus, we merged these themes together to form the news variables. For example, the themes “New scientific research” and “Scientific research process” were combined into “Scientific progress” and “Scientific debate” were merged into “Public perception”.

Frame: According to Entman (1993, p.52), framing primarily refers to the selection and salience. “To frame is to select some aspects of a perceived reality and make

them more salience in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or recommendation for the item described. Our enquiry in the research on the media representation of global scientific controversies is to examine which salient objects and attributes the media agenda employ to frame public understanding of GMO. Moreover, it aims to understand how and why such frames are framed (or ignored) by the media. Consequently, the term “frame” used in the research is not only the attributes of presentations or attributes of objects in the stories but also the construction of news stories’ meaning. The variable “Frame” was adopted from previous research on media coverage of science and technology (Bauer et al. 1995, Durant et al. 1998, Nisbet and Lewenstein 2002). All articles were coded according to their “frame”: “Progress”, “Economic prospects”, “Policy”, “Ethical concern”, “Pandora’s box”, “Run-away”, “Nature/nurture”, “Public accountability”, “Globalisation”, “Long-way away” and “Other or unclear”. While the number of “Run-away” articles was small, this variable was then merged with “Pandora’s box” to form the new frame “Disaster” (presented in the finding). Similarly, due to their infrequent existence, articles which were framed as “Nature/nurture” and “Globalisation” were added to “Other or Unclear”.

Type of coverage: Aiming to highlight differences in media construction of GMO, the study used event-based and issue-based variables to access the focus of news coverage. Event framing of news was coded when the news item focused on a specific example, a current moment, a single case study, person-central, or reported a particular event, a conference, an announcement. In brief, if the story presented a snapshot of “what”, “when”, “where”, it would be coded as event-based news. In contrast, the story that provided a broader and more general background or gave more analytical focus on AI issue was coded as issue-based item. In short, issue-based story emphasised the process, aiming to answer the question of “how” and “why”.

Risk and benefit: Whether the coverage of GMO referred to risk or benefit consequence and what types of risk or benefit it concentrated on were coded based on Strelakova (2015) content analysis of nanotechnology in US news. This study assessed the presence, intensity and specificity of risks and benefits. Intensity and

specificity were coded on a 5-point Likert scale, in which intensity was ranged from very low (benefits/risks are downplayed and referenced as insignificant) to very high (benefits/risks are unavoidable and overwhelming). Specificity was coded as not at all specific (benefits/risks are mentioned but not discussed) to very specific (benefits/risks were mentioned and discussed as specific examples or case studies in particular situations) (See Appendix 5 – Coding Book).

Localisation: The study used a ‘localisation’ variable to identify how global science controversies were localised in Vietnamese media. Localisation reflects a news value in which a global story is framed locally, following cultural and social diversity. O’Mahony and Schäfer (2005) comparative study on German and Irish media discourse on human genome research found that global science is “localised” differently due to national interest and identity of each country. It consolidates with another analysis on Japanese and European newspapers coverage of biotechnology by Hibino and Nagata (2006) that in spite of sharing many similarities, cultures differ the media framing of biotechnology. Localisation reflects a news value in which global story is framed locally in accordance with the cultural and social diversity. However, several studies on science journalism found that the media in developing countries source most of their science news output from stories originally published in the USA, UK, Australia, Japan and other European advanced countries (Shanahan 2006, Massarani and Buys 2007, Tagbo 2010, Dutt and Garg 2012). In order to re-determine whether global or local dominates the media framing of scientific controversies in developing countries, this study particularly focused on the level of national linkage in the news articles. “Localisation” was determined by “locality of event/ issue” variable. By identifying the geographic origin of the story that where is the event/ story mainly being conducted, the study aims to explore whether international or local event/ issue dominated Vietnamese science stories. If the issue was “Internationally originated”, whether it referred to local scientific events, people, applications and implications, debate and policy was further identified to judge the occurrence and intensity of “localisation” frame.

Source: In order to identify the source presented in the story, the study coded the number of sources cited as “no source”, “single source”, “two sources” and “more than two sources”. In case the news items has at least one source, it was then coded

as direct or indirect source, role of source and origin of source. Notably, by identifying the role of source, the study aimed to explore whether expertise, political, industrial agents and institutions or lay public and non-governmental organisation have significant impact on AI news representation. Further information about the originality of source were also figured out to determine whether international or local referee dominate Vietnamese science news.

Explicit stance towards GMO: This refers to the extent to which the article presents their explicit favour, oppose or maintains a neutral position towards the science event/issue being covered. Those have common discourse elements such as: *should apply, recommend, agree, encourage* or focusing on the GMO benefits were coded as favour of S&T. On the other hand, stories referring to discourse of *should not apply, disagree, opposed to* or emphasising the GMO threats were added to opposing attitude. The discourse that focusing on *more research should be conducted in the future* or concentrating on fact or information referred to the neutral and balanced sentiment.

Underpinning scientific processes: As shown in the literature, science reporting in developing countries tended to be uncritical, superficial and usually overwhelmed with benefit favour but lacked scientific evidence support. In this study, the author aimed to explore to which degree Vietnamese newspapers coverage of GMO were supplemented by the scientific information. The sampled articles were coded *Yes* if they mentioned and explained any aspect of scientific process (such as *“Aimed and object”, “Methodology”, “Results”, “Strength and limitation”*) and as *No* if they lacked such information. Furthermore, in order to determine any financial support for the presented research project, the coders coded *Yes* if the article mentions the name of state or industrial funds. If the financial sponsorship was not disclosed in the news, the chapter is able to suggest that the media might hidden political or commercial interests underlying the research. By this, the media might skew public opinion towards GMO.

Along with the researcher as a prime coder, a second coder, who has a BA in journalism, was hired for the coding. The second coder was trained in four weeks how to interpret the coding frame before taking part in a preliminary coding to check the correspondence rate between the two coders. In order to reach a considered

acceptable coding agreement for a manual content analysis coding, according to Bryman (2012), both coders independently need to co-code a randomly selected 10% of the total samples until the pilot coding achieves a Krippendorff's alpha for every variable of at least 75%. In our study, approximately 30% of the total samples (120 articles) were co-coded by the two coders. We used ReCall3 online tool to calculate the inter-coder reliability coefficient of all variables until they all reached a level of over 80%¹⁵.

Table 5.1. Reliability test for GMO

Variable	Krippendorff's alpha
Publication	100
Date	10
Length	10
Authorship	94.1
Genre	94.2
Type of headline	92.9
Tone of headline	85.3
Types of lead	100
Tone of lead	87.9
Section	95.5
Supplementary materials	100
Readers' comments	100
Topic	96.5
Theme	90.6
Frame	90.1
Type of coverage	93.3
Type of controversy	94.1
The presence of risk and benefit	96.6
Type of risk	84.0
Type of benefit	93.1
Intensity of risk	87.4
Intensity of benefit	83.0
Specificity of risk	92.2
Specificity of benefit	84.3
Locality of the event	100.0
Localisation	95.8
Original source of international story	100.0
Source of translated story	95.5
Number of sources (direct/ indirect)	100
Type of 1 st source	100.0
Role of 1 st source	95.3
Origin of 1 st source	80.6

¹⁵ 75% is acceptable

Type of 2 nd source (direct/indirect)	100.0
Role of 2 nd source	91.8
Origin of 1 st source	84.1
Metaphor headline	100.0
Metaphor lead	93.2
Metaphor body	83.5
Metaphor last paragraph	100.0
Evaluation	84.1
Solution	100.0
Aimed and object explained	100.0
Methodology explained	100.0
Result explained	100.0
Theory explained	100.0
Strength and limitation explained	100.0
Funding	100.0

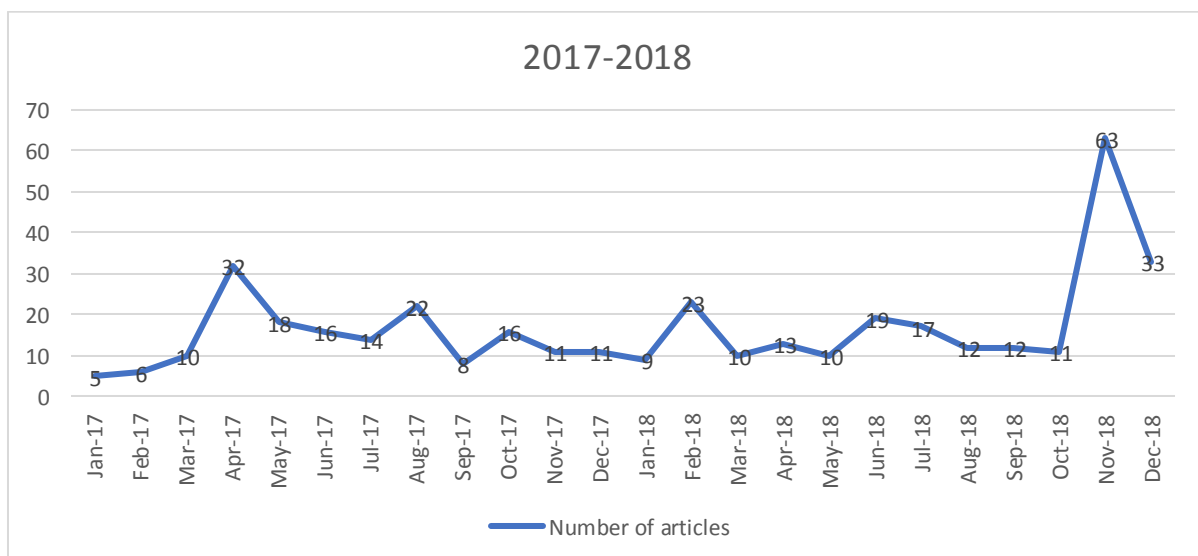
5.4. A modest and superficial coverage of GMO

Overall results from the content analysis showed that during the period 2017 and 2018, Vietnamese journalists did write about genetically modified organism. However, the number of GMO articles in the two examined years was not high. Of the total 401 articles, 169 pieces were published in 2017 and 232 stories were published in 2018, dispersing across 81 news sites. On average, the 81 newspapers in the sample published 16.7 articles in the two years. The lacked information about the intensity of S&T news during the analysed period makes it unable for any quantitative comparison between GMO news and general S&T news. Yet compared to the media coverage of AI (which is the second case study of the thesis – see the next chapter), it is apparent that the volume of GMO stories was much smaller, two times less than AI stories (1228 for the same period). *Nong nghiep*, *Dan tri*, *Tuoi tre*, *VTV*, *Suc khoe doi song* were a few newspapers that gave substantial attention to GMO issue, which each published more than ten articles during the studied period while most of the remaining newspapers produced under three (data not shown). Among the most extensive coverage to the issues of GMO, *Nong nghiep*, the specialist newspaper for agricultural development published by MARD had the highest number of publications (35 articles), followed by the science- and education-

focused online newspaper *Dan tri* (27 articles) and the general daily broadsheet *Tuoi tre* (26 articles), respectively.

The intensity of news coverage remained low during the examined period, except a sharp peak in November 2018, which was concurrent with the controversy about two Chinese gene-edited babies Lulu and Nana. Along with the international media immediate and intensive response to the defiant human gene-modified experiment, local newspapers were in fever of the science's ethical violation and unexpected perils for the world first modified twins. Breaking news and other in-depth coverage, i.e. opinion, analytical feature, about the biologist He Jiankui, Crispr-Cas9 genome editing system as well as the unknown impact of gene overwhelmed the Vietnamese online news. 78% of articles (49/63 - data not shown) found in November 2018 were about the CRISPR genome editing affair. For instance, *Tuoi tre* ran a series of articles reporting the world-shaking event, analysing the potential dreadful consequences of genome modification, Vietnam policy about gene editing and presenting several human-interest topics related to He Jiankui, such as his biography and ambition to be a great Einstein of China. November 2018 also recorded the highest public engagement in media coverage of GMO with two articles reached the largest and second largest number of comments, with 122 and 69 responses, respectively.

Figure 5.1. The number of articles in 2017 – 2018



Alongside the modest coverage is another issue: the superficial GMO reporting. This is manifested in several key aspects. First, there was a high proportion of straight news found in the study. As shown in **Table 5.2**, compared to other in-depth formats, i.e. feature, opinion, interview, GMO was more often covered in the form of short and brief news, accounting for more than half of the total samples (51.6%). Unsurprisingly, longform/mega story, which provides a large amount of content, often with multimedia elements, was not used to cover GMO. Opinion/ Editorial, which is commonly known as one of the most-read and influential section to public opinion and action, as well as policy making process in a newspaper, was also uncommon in Vietnamese media coverage of GMO (Dijk 1995). The fact that only 1% (N=4) of the two-year sample presented the newspaper's viewpoints on GMO innovations and policies suggests that the issue was not seen as one of paramount social significance or urgency.

Table 5.2 Genres of GMO news articles

Genres of news articles	Frequency	Percentage %
Straight news	207	51.6
Feature	102	25.4
Opinion/ Editorial	4	1.0
Interview	10	2.5
Gallery	9	2.2
Others	68	17.0
Total	401	100.0

Second, the superiority of straight news to other in-depth formats suggests that Vietnamese news coverage of GMO was episodic. Apart the peak in November 2018, **Table 5.3** shows that two-thirds of sampled stories were event-based, focusing on what happening around GM technology, such as a genome editing discovery, a new licenced GM seed, an approved GMO policy, a possible association between biotech tobacco and cancer. Particularly, both general newspapers and science-focused newspapers, which are supposed to provide public

with in-depth science reporting, were predominantly episodic. As shown in **Table 5.3**, 66.1% of articles in general newspaper and 64.8% of articles in science-focused newspaper emphasised single event or individual case rather than applying a wide and deep angle to GMO and bringing the public to the comprehensive context of GM debate. A chi-square test of independence also shows there was no statistically significant difference between the two categories' tendency to frame their stories ($X^2(1, N=401)=0.03, p>.05$) (**Table 5.3**).

Table 5.3 Type of coverage by type of news outlets

	Total N=401	Gen. newspaper n= 327	Sci. newspaper n=74
Event-oriented	65.8	66.1	64.8
Issued-oriented	34.2	33.9	35.1
$X^2=0.03, p >.05$			

Third, as a result of the event-orientation, there is a lack of critical analysis about GMO. The media tended either excessively celebrate the benefits or exaggerate the risks of GMO. Easy-to-digest content that could promptly attract public attention were preferred to analytical and investigative coverage through in-depth journalistic forms, such as features, commentaries and the likes. Only a few articles were found to position GMO events and issues in Vietnamese social, economic and political context or to inform public with comprehensive scientific evidence about GMO's advantages and disadvantages. Yet these stories were not extensive and profound enough to provide the public with comprehensive information about how and why of such benefits and risks. As shown in **Table 5.4**, reviewed articles rarely presented GMO events and issues with an efficient evaluation of the scientific rigour behind them. Only a minority of sampled stories provided historical background of GMO stories, explaining the research aim and object, analysing methodological strength and weakness, grasping the findings with limitations or flaws, judging the weight of evidence, ethical norms and value, ect.

Table 5.4 Mentioned science aspects

Scientific aspect	Percentage
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Aim and object	0.2
Methodology	15.5
Result	6.2
Strength and Limitation	3.7
Funding	0.5

The superficial coverage of GMO additionally manifests in the shortage of two-source reporting. Of the 401 stories, only 182 (45% - **Table 5.8**) have two or more than two sources of citation. The domination of one source story can put audience in a biased approach to GMO. No matter how the source is either pro or against GMO, it provided only one-sided viewpoint on the issue. For long-term consequence, this unbalance reporting would mislead public understanding of and response to GMO risk and benefit.

The modest and superficial coverage of GMO is consolidated by findings from the in-depth interviews. The journalists confessed that their news outlets neither had specialist science newsbeat nor specific instructions on covering science issues. As science is not a prime concern of the newsroom, subjects like GMO were seen as pretty unimportant, only acquiring a position in the news pages if they are sensational enough to attract high public interest. C4 - a veteran science journalist who had run a series of investigative articles about GMO - described the situation:

When the government does not show interest in GMO, the media find no reason to report the topic. GMO is not urgent enough for both policy makers and newsrooms to give priority to. News managing editor sometimes ignore GMO stories even though journalists propose an interesting and meaningful topic.

Added to resistance from government and news organisation, the journalists paid little attention to GMO partly because for most of Vietnamese, GMO has not been an object of much public interest. Almost all participants mentioned the low public interest in GMO and the benefits as well as risks they bring is an indicator for the media episodic coverage:

While ordinary people neither understand nor care about GMO, we only cover GMO news about as it happens. Honestly, we haven't done well to make

public informed about GMO. We lack expertise and resources to dig into the issue. That's why GMO is often sunk deep at the bottom of news. [A3]

Such a newsroom culture and audience interest left the journalists negligent to their reporting. On the one hand, they chose to avoid GMO topic, as B1 said "GMO is one of the sensitive topics in Vietnam. Because of its complexity, the controversy over GMO moves out of science to become political and social issues. GM policies have wavered among concerns over the GM implications and development goals. Thus, Vietnamese news media often flinch from reporting". On the other hand, they were easily exploited by the GMO commercial sources. The giant biotech companies like Monsanto, Syngenta manipulate lobbying and public relation tools to spotlight journalists, both directly and indirectly, to favour their products partially. It was not unusual that journalists scraping the PR releases, conference papers or research announcements to form their news without scrutinization. As two participants told us:

- My newspaper and other news organisations that I know receive financial sponsorship from seed companies to give their GM products positive coverage. While news media are bribed by biotech giants, the critical opponency to GMO is weak and separate. [C3]
- Journalists are facing a lot of pressure in reporting GMO, particularly when MARD is interfered by the biotech companies through their PR campaign. [C6]

Condensing the content analysis findings together with these anecdotes suggest that similar to other scientific topics, GMO did secure a place in Vietnamese newspapers, but it was unable to sustain a high media attention as political and economic topics. Without a dedicated science desk and newsroom's priority, GMO stories were generally superficial with event-based content and easily affected by commercial interest groups. While news media plays a key role in shaping public perception of science, the lack of intensive and in-depth reporting probably makes GMO hardly a familiar topic to Vietnamese consumers, as a specialist reporter observed:

Based on what I've learnt from my fieldtrips, I think Vietnamese peasants know nothing about GMO. Their decision to choose either GMO or non-GMO crops is merely based on the promising increased cultivation productivity with low production costs and the biotechnology companies' advertising

campaigns. Their poor perception is partly caused by the media insufficient coverage of GMO because as similar to a large number of Vietnamese citizens, they obtain science knowledge from news media. [C3]

5.5. Tendency to depict GMO as scientific progress and promising industry

The news articles in our dataset covered a wide range of topics, including “plant” (24.9%), “food” (24.4%) and “animal” (4%). Notably, the most frequent issue was about the association between GM technology and “human health” (38.4%) (**Table 5.5**). Yet Vietnamese news media is highly inclined to the government’s support for GMO development, GMO was dominantly depicted as a promising science achievement for the agricultural industry. Vietnamese media coverage of GMO was epitomised by an overwhelming absence of reporting on controversy, with more than two-thirds of the article reporting GMO without any controversy (**Table 5.5**). Furthermore, the theme concerning both positive and negative consequences of GMO, “scientific or technological applications and implications”, was rarely found in our content analysis. Conversely, the data show a heavy prominence of themes that highlight the positives of “GMO trading and industry” (31.9%), and “GMO scientific process and achievements” (23.9%). Despite of debates persisting around the globe over the GM risks and benefits, Vietnamese media merely see GM as a scientific advance that is significantly beneficial to crops yield, environmental sustainability and human health. These news articles often focused on the practical application of GM in trading and industry as well as the effort of government and industrial agency to accelerate the GMO commercialism. Journalists were also favour to the latest research breakthrough from outside the border, i.e. GM mammals for academic experiment¹⁶ the genome editing baby¹⁷ or research project using gene modified technique to boost production of commercial hens¹⁸. The preference of GMO developments outreached the stories about “Public perception of science and technology” (12.5%) and “Scientific and technological policy and legislation” (8%).

Table 5.5 The major topics, themes and controversies of GMO articles

	Number of articles N=401	Percentage (%)
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¹⁶ <https://suckhoedoisong.vn/dong-vat-chuyen-gen-dung-cho-nghien-cuu-khoa-hoc-va-chua-benh-n149873.html>

¹⁷ <https://vietnamnet.vn/vn/suc-khoe/cap-song-sinh-bien-doi-gen-ha-kien-khue-tuyen-bo-van-con-dua-tre-thu-3-491585.html>

¹⁸ <https://laodongthudo.vn/ga-bien-doi-gen-co-the-de-trung-tu-cac-giong-khac-nhau-49026.html>

Topic		
Plant	100	24.9
Food	98	24.4
Animal	32	8.0
Human health	154	38.4
Others or Unclear	17	4.2
Theme		
Scientific process and achievement	96	23.9
Applications and implications	30	7.5
Policy and legislation	32	8.0
Trading and industry	128	31.9
Public perception	50	12.5
Others or Unclear	65	16.2
Controversy		
Intra-controversy	1	0.2
Political controversy	1	0.2
Economic/financial controversy	2	0.5
Environmental controversy	1	0.2
Ethical controversy	20	5.0
Medical controversy	42	10.5
Multi-controversies	47	11.7
No-controversy	287	71.6

In order to test the newspaper's different approach to GMO, a chi-square test of independence between the science-focused and general newspapers was run. **Table 5.6** shows there was no statistically significant difference between types of newspapers and the major science themes in the news story ($X^2 (5, N=401) = 9.64, p > .05$). **Table 5.6** shows that science-focused and general newspapers were almost identical in framing GMO. Both science-focused press, such as *Nong nghiep* and *Dan Viet* and general daily such as *Tuoi tre* and *Vnexpress* were more likely to cover generic research and economic issues, such as golden rice contains vitamins, anti-herbicide resistant plant increases yield, GM plants are able to survive drought, imported and exported bt maize and cotton, the expanse of GM cultivation in Vietnam. On the other hand, they were less interested in GMO dilemmatic application and implication, policy and regulation as well as public reaction towards GMO products. However, general newspapers tended to give more emphasis on public involvement in biotechnology debates. 14.1% of articles published in general newspaper focusing on public perception of GMO while only 5.4% of those in the science-focused publication presenting public awareness of and reaction to GMO debate.

Table 5.6 The association between type of newspaper and GMO theme

	Sci. newspaper n=74	Gen. newspaper n=327
Scientific process and achievement	32.4	22.0
Applications and implications	4.1	8.3
Policy and legislation	5.4	8.6
Trading and industry	37.8	30.6
Public perception	5.4	14.1
Others or Unclear	14.9	16.5
$\chi^2 = 9.64, p > .05$		

The media tendentiously presenting GMO as a promising scientific achievement for industry was also reflected in the dominance of framing devices that accent elements of scientific progress and economic development. Approximately half of the article reported GMO within “economic prospect” and “scientific progress” frames (**Table 5.6**). Many articles that were framed by “scientific progress” primarily celebrated GMO research and development program, priming audience to understand GM technology as a great human achievement. It was usually used in stories presenting potential economic, social and environmental benefits associated with new GM discoveries. The salience of GMO cutting-edge in the media is perhaps unsurprising given GMO’s prominent status in the national agronomic development scheme. Despite the prevalence of reported benefits, GMO was occasionally seen as an existing or possible threat to human, with 15.7% of stories were framed as “Disaster”. In these cases, however, news outlets rarely provided detailed explanation and evidence to support their concerns on GMO consequences. Further, they hardly went beyond the limitations of laboratory to analyse the GMO’s influence on social interests and ethical values as well as the public involvement and participation in the establishment and management of a GMO regulation. **Table 5.7** illustrates only 3% and 3.5% of total samples was indexed to the frame “Public accountability” and “Ethical concern”, respectively.

Table 5.7 Frames of GMO articles

Frame	Number of articles (N=401)	Percentage (%)
Scientific progress	91	22.7
Economic prospect	109	27.2
Policy	30	7.5
Ethical concern	14	3.5
Disaster	63	15.7
Public accountability	12	3.0

Localisation	15	3.7
Others or Unclear	67	16.7

The media favour of scientific progress was further supported by the results indicating the main actors that have been most frequently cited in media coverage of GMO. As seen in **Table 5.8**, nearly half of articles quoted “expert and research institutions” as their first source, whereas about one third quoted a biotechnologist or biotechnological organisation as their second source of information. The vast majority of these expertise sources were crop breeders, scientists and research institutes, both from inside and outside Vietnam. *Nong nghiep* and *Dan tri* – the two science and agriculture-oriented newspapers – had the highest number of academic sources among the total 81 online news sites. On the other hand, despite the heavy reliance on “trading and industry” theme and “economic prospect” frame, “industry and business” sources were not popular in the media coverage of GMO. As seen in **Table 5.8**, only 7.6% and 8.9% of first source and second source were actors who represented industrial or commercial corporations. Given that GMO is a sophisticated issue that is unfamiliar to most journalists, they were more likely to base their arguments on scholarly knowledge and perspective of the subject.

Apart from experts, news stories about GMO were also relied on governmental official and agencies as source of information. “Politician” and “governmental organisation” were the second most popular first source found in the content analysis. All included, 21% and 26.4% of first and second source found in the study were ministers, directors or managers in charge of science and technology in Vietnam (**Table 5.8**). *VTV*, the online newspaper managed by Vietnamese National Television was the leading newspaper quoting state source for their news coverage of GMO (data now shown). Notably, non-elites, especially original citizens, who are often muted in the mainstream media, were also acknowledged in the Vietnamese news coverage of GMO. *Nong nghiep* was the newspaper often presenting how local farmers perceive and react to GMO. The growing attention to lay public may be a signal for a shift of Vietnamese media to promote the citizen’s active engagement in science controversy. It contributes to empowering the public voice in science forum. Citing lay community as news source also reflects the media transformation to a greater diversity and democracy in news production. However, it is observed from

the data that citizen's quotations dominantly favour to GM crops, as a result of the state and media's positive stance on GM progress. Farmers were often asked to praise bt maize for productivity and cost-efficiency, especially as compared to traditional corn. In general, science experts and politicians appear the most influential source of GMO information.

Table 5.8 The types of sources cited in GMO articles

Source	First source^a (N=315)	Second source^b (N=182)
Expert and research institution	46.8	38.4
Lay community	11.4	15.4
Politician and governmental organisation	21.0	26.4
Industry and business	7.6	8.9
News wire	7.6	5.0
NGOs	4.1	6.0
Others	1.9	0.0

a. The first agent/agency was cited in the story
b. The second agent/agency was cited in the story

From the in-depth interviews, there are several possible reasons for the media's tendency to frame GMO as a scientific breakthrough. First and foremost, it appears to emerge from the journalist's perception of science journalism as a mere conduit for science. Few participants were well aware of journalism's role in helping public and policy makers to be critically informed about and to rationally react to science controversy. According to B2:

Reporters who are in charge for science reporting don't have adequate understanding of their profession. They are unable to look for and read information below and between the line. They simply celebrate the happenings without any concern on manipulated or misleading information.

C6 added that "newsrooms rarely require their staffs to go beyond complicated science issue". Thus, it was not unusual for a news release from a peer reviewed journal or state announcement to spot in the mainstream media. There was a lack of evidence-based critique in the Vietnamese news about the risk and benefit of GMO. Both supportive and opposing coverage of GMO failed to provide sufficient science evidence for their arguments. According to B2, the uncritical reporting becomes excessively dangerous especially in term of medical and health news.

For those who have an appropriate understanding of science journalism, they found themselves unable to make changes because of their limited knowledge and skills to deal with complicated and controversial science issues. According to Russell (2010), trained and experienced science reporters will satisfy the news media and public demand for critical coverage of complicated science disputes. While Vietnamese journalists lack expertise to cover science, they tend to do the breaking news, imitating the scientist's discourse and state report on biotechnology instead of excavating scientific caveats, such as the long-term consequence of genome manipulation or the possible harm of GM crops to environment. Several participants confessed:

- We need to base our reporting on leading biotechnology research institutions in America and Europe or take the viewpoints of Vietnamese Ministry of Science and Technology for granted. Debate over GMO is endless, journalists would get lost without scientist's support. Without assistance of scientific community, media would make audience confused. [C5]
- News organisations often depend on their scientific consultants for science coverage. If their experts support GMO, they would be on the side of GMO. On the other hand, they neither cover GMO stories nor avoid reporting its potential risks. [B2]

5.6. Preference of benefit to risk

As local scientists tended to espouse GMO, either actively or passively, it is not surprising to find that the Vietnamese media generally promoted GM advantages. As a result of media preference to scientific progress, our content analysis finds a general positive coverage towards the development and implementation of GM technology. As shown in **Table 5.9**, approximately two thirds of sampled articles presenting GMO advantages. Specifically, 37.9% mentioned "benefit only" and 26.7% mentioned "both risk and benefit". Fewer stories were associated with GM risks, with 20.4% presenting "risk only" and 26.7% "both risk and benefit". The equivalent coverage of risks and benefit suggests a media's rising awareness of GMO long-term consequences. Along with exceptional profits that modern

biotechnology brings to human beings, there are several social and ethical risks associated with GMOs that need to be well-acknowledged.

Table 5.9 Risk and benefit presence in GMO articles

	Frequency (N=401)	Percentage (%)
Benefit only	152	37.9
Both risk and benefit	107	26.7
Neither risk nor benefit	60	15.0
Only risk	82	20.4

In order to identify whether GMO research and application for human health, plant, animal or food were more associated with risks or benefits, a crosstab test was run and found a significant difference between topic and the presence of risk and benefit ($X^2(12, N=401)=117.07$, $p<.001$). Data in **Table 5.10** show both sides of risk and benefit was highly associated with stories about GMO application in medical treatment and human health and topic related to animal genome editing. The presentation of only benefit was more likely presented in connection with innovative GM development in agriculture whereas media concern on risk was often raised in GM food topic.

Table 5.10 The association between GMO topic and the presence of risk and benefit

	Topic				
	Human health	Plant	Animal	Food	General
Both risk and benefit	35.1	14.0	40.6	25.5	5.9
Only risk	14.9	14.0	9.4	41.8	5.9
Neither risk nor benefit	13.6	7.0	15.6	15.3	70.6
Only benefit	36.4	65.0	34.4	17.3	17.6
$X^2 = 117.07, p<.001$					

In order to identifying the association between risk and benefit and the primary articles' theme, a chi-square test of independence was run and found a significant difference between the presence of risk/ benefit and the primary theme of each article ($X^2 (15, N=401)=221.40$, $p<.001$). **Table 5.11** shows a cross-tabulation between the two variables.

- Stories about “*scientific process and achievement*” were more likely presented with “benefit only” (41.4%) and “both risk and benefit” (21.5%) than “neither risk nor benefit” (8.3%) and “only risk” (6.1%).
- Stories about “*applications and implications*” were more likely discussed in terms of “both risk and benefit” (15.9%) and “only risk” (9.8%) than “only benefit” (3.3%). It was not covered in “neither risk nor benefit” (0%).
- Stories about “*policy and legislation*” were more likely discussed in terms of “both risk and benefit” (37.5%) and “only risk” (13.4%) than “only benefit” (4.6%) and “neither risk nor benefit” (3.3%).
- Stories about “*trading and industry*” were more likely discussed in terms of “only benefit” (42.8%) and “only risk” (35.4%) than “neither risk nor benefit” (20%) and “both risk and benefit” (17.2%).
- Stories about “*public perception of GMO*”, including public engagement in GMO debate were more likely discussed in terms of “both risk and benefit” (29.9%) and “only risk” (14.6%) than “neither risk nor benefit” (6.7%) and “only benefit” (1.3%).

On the whole, news media tended to frame GM scientific achievements and GM commercialism with more benefit. Discussions over the ongoing applications and implications of GMO, the legislative management of GMO as well as public engagement in GMO process were primarily associated with both side of positive and negative discourse.

Table 5.11 The association between GMO theme and the presence of risk and benefit

	Risk and benefit presence			
	Both risk and benefit	Only risk	Neither risk nor benefit	Only benefit
Scientific process and achievement	21.5	6.1	8.3	41.4
Applications and implications	15.9	9.8	0.0	3.3
Policy and legislation	37.5	13.4	3.3	4.6
Trading and industry	17.2	35.4	20.0	42.8
Public perception	29.9	14.6	6.7	1.3
Other or unclear	0.9	20.7	61.7	6.6

$\chi^2 = 221.40, p < .001$

Notably, the most common benefit and risk were both related to “*health and medical issues*”. **Table 5.11** reveals that 44% of articles mentioned prospects and 44.4% articles mentioning threats focused on GM implications to human health and medical treatment. While the GM benefits often referred to nutritional value of food and gene therapy for medical treatment, concerns over GMO were often surroundings potential harm to human health such as the GMO food potential to trigger allergy or contribute to the development of cancer. The second frequently presented advantages was biotechnology utility for economic development (40.4%): cost-efficiency, quality improvement, soil protection, greenhouse gas reduction and higher yield. For example, an article with headline “Bt maize ploddingly increases cultivating area”¹⁹ stated that genetically modified corn was transforming the local economy in both macro and micro levels. In term of micro-advantage, GM crop potentially decreased labour cost and increased yield productivity whereas at the macro level, it could drop the pressure of imported corn for animal feed. Both expert and lay person were cited to reinforce the media promotion to GM economic benefit. In contrast to the general advocate to GM economic benefits, only 1.1% of the articles mentioning risk referenced to economic consequences. The finding suggests a highly consistent attitude towards the GMO as an important contribution to Vietnamese economic development. There was little mentioning of the common controversy around the potential impact of GMO on local agronomy, such as the farmer’s increasing dependence on seed monopoly companies, the economic loss caused by superweeds and superpests. Along with the infrequent coverage of economic risks, GM’s impact on environment was not presented in the media, with only one story mentioning environmental cost as a central risk issue. On the other hand, news media raised more scepticism about “multi-risks” (37%) and “ethical risk” (15.9%). A substantial focus was on the moral aspects emerged from the genome editing scandal in China.

Table 5.12 Type of GMO risks and benefits

	Frequency	Percentage
Type of risks (N=189)		
Economic issues	2	1.1
Ethical issues	30	15.9
Health and medical issues	84	44.4
Environmental issues	1	0.5

¹⁹ <https://danviet.vn/hqo-bien-doi-gen-i-ach-tang-dien-tich-7777892057.htm>

Multi-risks	70	37.0
Other or Unclear	2	1.1
Type of benefits (N=259)		
Economic issues	104	40.2
Social issues	1	0.4
Ethical issues	1	0.4
Health and medical issues	114	44.0
Environmental issues	4	1.5
Multi-benefits	32	12.4
Other or Unclear	3	1.2

In terms of specificity and intensity of risk and benefit, the overall observation is that they ranged from moderate to high. As shown in **Table 5.12**, both intensity and specificity of GM risk in the media were slightly lower than benefit (M = 3.12 vs M = 3.42 for intensity; and M = 3.46 vs M = 3.95 for specificity). While the intensity of benefit was moderate (M = 3.42), the specificity of benefit was high (M = 3.95). Science reporters often detailed GMO benefits with specific data about GM increased crops and productivity. Several case studies were also introduced to augment the supportive argument. For instance, in an article promoting GM maize cultivation²⁰, GMO was celebrated as a critical source of agricultural development, a remarkable change that was greatly welcomed by all farmers. In addition to statistics, reporters used interviews with two lay leaders and a farmer to reinforce the huge benefit of GMO to farming:

As a farmer who is planting and taking care of genetically modified maize, Ms. Nguyen Thi Hoa, Phu Xuyen village, Phu Chau commune understands better than anyone about its economic efficiency and potential. Ms. Hoa told that her family has been allowed to participate in the experimental maize crop since the Spring 2017. After monitoring, caring, and harvesting, she was surprised by the maize's productivity. "It consumes less time and care than other traditional maize, so it reduces a lot of costs. In this Winter crop, my family plans to spend 1800 square metres for this genetically modified maize

In addition to interview, other supplemental materials, such as image and box, were frequently used to specify the presentation of GM benefits. 62.8% of science content

²⁰ <http://kinhthodothi.vn/ngo-bien-doi-gen-qiong-cay-chu-luc-tren-vung-dat-bai-299653.html>

was supplemented by pictures/images, followed by hypertext/ links with 13.8% and boxes with 12.3%, respectively (data not shown).

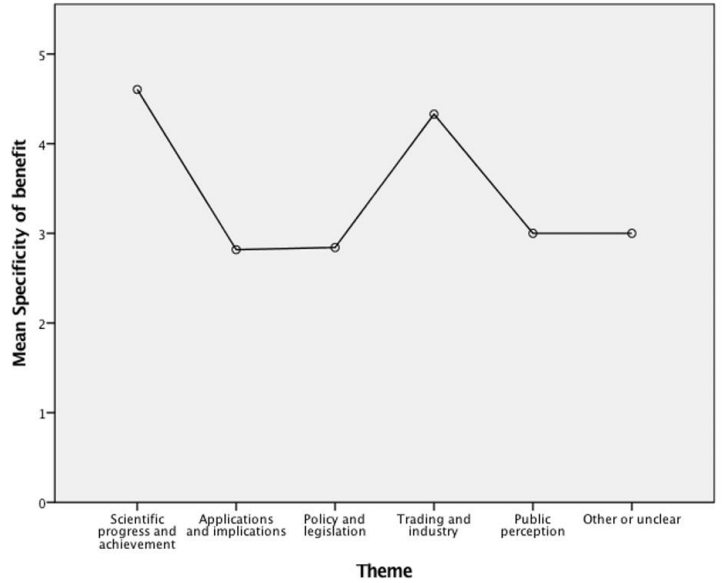
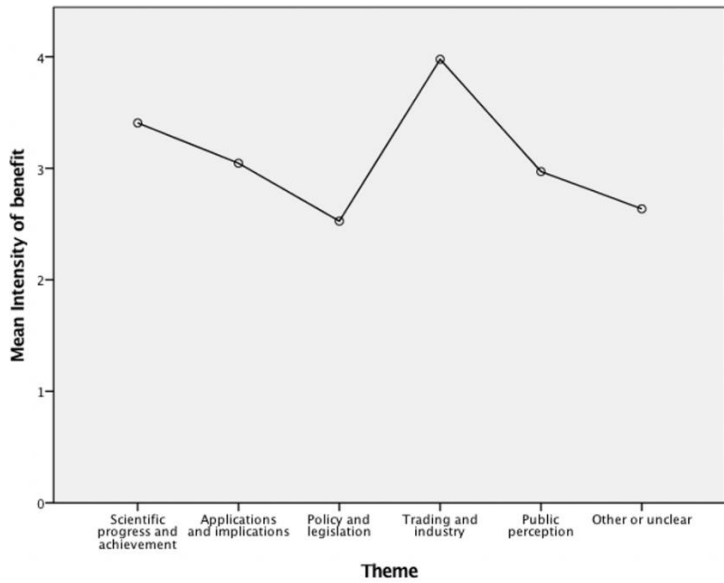
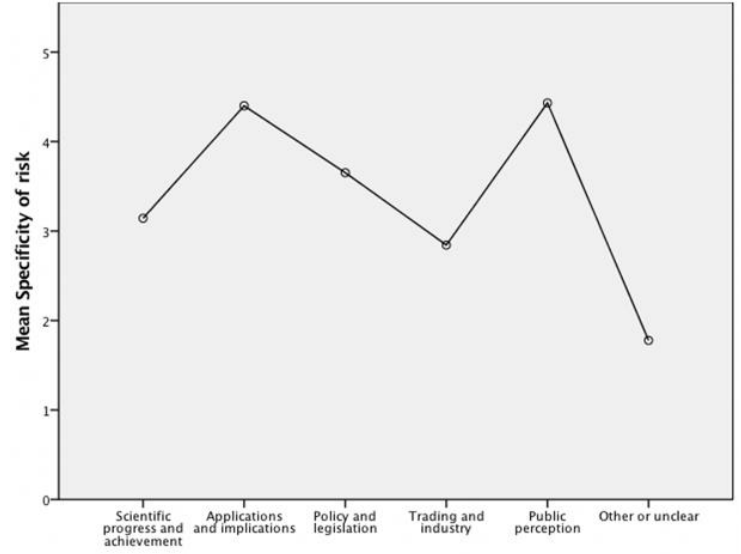
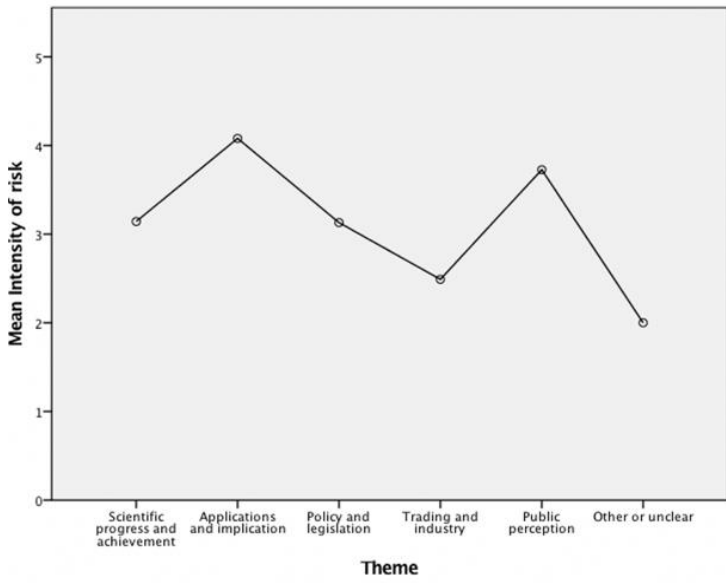
Table 5.13 The intensity and specificity of GMO risk and benefit

		Mean					
		Scientific process and achievement	Applications and implications	Policy and legislation	Trading and industry	Public perception	Others or unclear
Risk intensity	3.12	3.14	4.08	3.13	2.49	3.73	2.00
Risk specificity	3.46	3.14	4.40	3.65	2.84	4.43	1.78
Benefit intensity	3.42	3.41	3.05	2.53	3.98	2.97	2.64
Benefit specificity	3.95	4.60	2.82	2.84	4.33	3.00	3.00

Specificity: 5-point Likert scale from 1 "not at all specific" to 5 "very specific"
Intensity: 5-point Likert scale from 1 "very low" to 5 "very high"
 *p <.001

In order to identify the association between the primary themes and the risk/benefit intensity and specificity, a set of independent samples ANOVA test was performed. The results show a statistically significant effect of themes on risk intensity/ specific and benefit intensity/ specificity at the $p < .001$ (**Table 5.12**). To illustrate the intensity and specificity of risk/ benefit across the themes, the chapter visualised their mean differences for six theme variables in **Table 5.12**. As can be seen in **Figure 5.2**, there are a significant fluctuation in all graphs, indicating that themes made different influence on the intensity and specificity of risk and benefit.

Figure 5.2 Graphical representation of mean differences in GMO risk and benefit intensity and specificity across themes



As a result of the benefit preference, the study found a more positive to negative attitude of journalists towards GMO. Nearly half of 335 stories that reflect their explicit attitude towards GMO was on side of GMO innovative research and product (49%) while 31% tended to reject GMO development. 20% of that gave a more balance and neutral viewpoint to the genomic technology and its applications.

Table 5.14 Explicit stance towards GMO

Evaluation	Frequency (N=335)	Percentage (%)
Opposed	104	31.0
Neutral	67	20.0
Favoured	164	49.0

A crosstabulation test found a significant difference between primary themes and the general journalists' explicit view about GMO issue presented in the stories ($X^2(10, N=335)=73.29, p<.001$). Crosstab examination shows that journalists tended to give opposing viewpoint towards stories which focused on themes *"applications and implications"* and *"public perception of GMO"*. On the other hand, they expressed their supportive attitudes to stories themed *"trading and industry"* and *"scientific progress and achievement"*. A more neutral stance was often given to discussion over GMO management and regulation (**Table 5.15**). However, the data show a widespread sensational discourse about GMO. Both supportive and opposing news stories consistently portrayed GM food as omnipotent tool for agricultural development or a Frankenstein threat for humankind. Several companies were allowed to be present to manipulate the risk/ benefit frame to generate public false hopes or intensify public fears of GM threats. For instance, by using the oppositional discourse of GM versus non-GM, genetically modified versus organic ingredients, food supplement companies, cosmetic supplier or organic baby food producers blatantly promoted their products without peer-reviewed evidence about the potential GMO harms to human health²¹. Many important topics were reported in form of soft news of "what you can eat or avoid" or infotainment that satisfies public curiosity rather than scrutinising the complexity of GM as well as its legal, ethical and political dilemmas. The distortion may inhibit citizens from well-informed decisions and actions. Without a critical knowledge, the public would find it hard to actively engage in democratic debate and decision about science policy.

Table 5.15 The association between theme and the explicit stance towards GMO

Theme						
Scientific process	and	Applications and	Policy and legislation	and	Trading and	Public perception
						Other or unclear

²¹ <https://anninhthudo.vn/thuc-pham-bien-doi-gen-gmo-hiem-hoa-khong-cua-rieng-ai-post355471.antd;>
<https://www.marrybaby.vn/nuoi-day-con/chon-thuc-an-dam-huu-co-be-thich-me-me-tiet-kiem-thoi-gian-che-bien;>
<https://www.elle.vn/bi-quyet-khoe-va-dep/son-organic-la-gi>

	achievement	implications	industry			
Opposed	10.8	63.3	46.7	25.9	57.1	29.2
Neutral	18.3	10.0	26.7	15.5	26.2	41.7
Favoured	71.0	26.7	26.7	58.6	16.7	29.2

$\chi^2 = 73.29, p < .001$

This general support to GMO, however, does not seem to stem from the journalists' agreement on GM benefits. Instead, as reflected in the observation of several in-depth interview participants, the state's tight rein on media was a major force setting a media preference of benefit to risk. As analysed in previous chapters, the state-owned media structure inhibits Vietnamese journalists from independent science reporting. In contrast to public-funded and private news outlets seen in other countries, Vietnamese media often lack editorial independence from official bodies and institutions. The institutional mechanism of censorship operates not only at editorial control but also at self-censored level. Thus, journalists find it hard to present their viewpoints solely based on journalistic norms. In some controversial cases, such as vaccination or Coronavirus, state benefit is prioritised to journalistic values. Science reporters are self-censored not to present information that putting pressure on the party or institution of authority. Regarding the GMO debate, although several participants showed their opposition or uncertainty to GM products, they confessed that their reporting sometimes did not manifest their personal perspectives. It is because the government considers GMO as a leading instrument for the expanded agricultural productivity and improved food security in the wake of climate change. An experienced science journalist bared his heart "We need to ground our opinions on the perspective of nation that we are serving, presenting the state's basic regulations of GMO [B5]. Another participant agreed: "No matter how my personal viewpoint is, I have to comply with the institutional perspective" [C2]. A weak promotion of governmental and institutional viewpoint even met with fierce opposition from their colleagues, as reminded by C4:

In a conference about GM technology, editor-in-chief of an agricultural newspaper criticises newspapers covering GMO limitations. He strongly accusing these news outlets for public fear of GM foods. In fact, his reaction is easy to understand because his newspaper represents the MARD.

Along with the state, the wide support of scientific community, whom journalists relied on for GMO information, also made significant influence on the media positive sentiment. C4 explains the local scholars' advocate of GMO for two reasons: "First, when the MARD is on GMO's side, the scientists, who are serving as state officials, would be, too. Second, the GM seed companies have run campaigns to gain the local scientists' advocacy. That's why few bio-scientists give opposing argument on GMO limitations. [C4]. In general, Vietnam news media tended to transmit the viewpoints of scientists and government who support GMO to make the issue more familiar to the public in a positive way.

5.7. The propensity for foreign source

Review about science journalism in developing countries show a heavy dependence on foreign sources for science reporting. Is it also the case in the Vietnamese media coverage of GMO? Is it dominated by international news, especially from the developed countries? The content analysis of GMO news in the Vietnamese online newspapers shows 55.9% (N=224) of stories, contributing a largest percentage of samples, cover GMO events and issues outside Vietnam, primarily transgenic achievements developed in the more scientific advanced countries. Compared to foreign news about modern biotechnology, the number of domestic stories was not as high, accounting for 36.7% (N = 147).

As a result of the tendency to rely on foreign stories, **Table 5.17** shows of the 224 articles that had international originality, a minority (7.1%) provided linking to local context, local policy and local people. The remaining majority (92.9%) drew no connection to domestic circumstance or gave a local reference to global stories. It was very often to find media overreaction to events, i.e. GM apple was approved for sell in the US market; double muscle pigs in Cambodia raise alarms; Chinese scientist shocked the world with CRISPR babies. Yet such events were rarely contextualised into local circumstances.

Table 5.16 The localisation of GMO news in Vietnam

		Frequency	Percentage (%)
Geographical scope of event/issue (Based on entire samples, N=401)	Foreign	224	55.9
	Domestic	147	36.7
	General	30	7.5

Link to local context (Based on the number of stories with an international scope, N=224)	Yes	16	7.1
	No	208	92.9
Source of original material (Based on the number of stories with an international scope, N=224)	Mainly original reporting	18	8.0
	Mainly translated reporting	206	92.0
Source of translation (Based on the number of translated stories, N=114)	Original scientific source	11	9.6
	Newspaper or website	95	83.3
	Unclear	8	7.0

Moreover, only a small number of stories about foreign events/issues was substantially written by newsroom staff (8.0%), whilst the majority was translated from foreign materials, including scientific source, such as academic journals, research announcements, newswire, open websites and, most prominently, foreign news outlets (92%) (**Table 5.17**). In term of translated stories, 83.3% of 114 mainly translated stories were from news organisations whereas only 9.6% were generated from academic reports. In several cases (7%), international news was duplicated without clear source identification.

Table 5.17 The association between GMO themes and locality of even/ issue

	Locality of event/ issue		
	Foreign	Domestic	General
Scientific process and achievement	40.6	3.4	0.0
Applications and implications	8.5	4.8	13.3
Policy and legislation	7.1	10.9	0.0
Trading and industry	19.2	52.4	26.7
Public perception	13.4	9.5	20.0
Other or unclear	11.2	19.0	40.0
$\chi^2 = 123.80, p < .001$			

In order to test the significant difference between themes and locality of event/ issue presented in the story, a chi-square test was run. Data show there was a significant difference between themes and locality ($\chi^2(10, N=401)=123.80, p < .001$). **Table 5.18** reveals the theme “trading and industry” reported more local than international event and issue. 52.4% of stories reported the domestic GMO events and issue were about trading, i.e. product development, field testing, marketing and sales. On the

other hand, data show scientific process and new achievement was more associated with foreign events and issues.

Table 5.18 Origin of the cited source

		Frequency	Percentage (%)
First source^a	International	201	63.4 ^a
	US	92	45.8 ^c
	China	42	20.9 ^c
	Others	67	33.3 ^c
	Vietnam	116	36.6 ^a
Second source^b	International	104	56.8 ^d
	US	43	41.3 ^d
	China	33	31.7 ^d
	Others	28	26.9 ^d
	Vietnam	79	43.2 ^d

a. Based on number of articles having one source, N=317
b. Based on number of articles having at least two source, N=183
c. Based on number of articles having international source, N=201
d. Based on number of articles having international source, N=104

In accordance with their dependence on foreign sources, international agents and/or agencies were more frequent sources in the sample of news stories at stake. As seen in **Table 5.19**, two thirds of the first source and more than half of the second source were the outsiders. Of 201 foreign persons/organisations whom were cited as first source, 45.8% were American and 20.9% were Chinese. A similar dominance of American and Chinese agents and agencies was found in 104 articles having at least two citations, with 41.3% and 31.7% of chances of being quoted, respectively (Data not shown). The tendency to cite American and Chinese sources of information was probably owing from the leading role of the US and PRC in biotechnology research and industry. Data from in-depth interviews indicate two main reasons for such general dependence on foreign sources. First, it is caused by the low status of GMO in the local academia. Despite GMO is acknowledged as the key force of agricultural development, the domestic laboratories often lack applicable financial and human resources to support GM research and development. Vietnam mostly adopts advanced biotech achievements from the developed countries, it is thereby local scientists are not interested in and competent to GM controversial issues. C4 said that “Is there any GMO expertise in Vietnam? No one. No institution.

There isn't any GMO experimental research in Vietnam. All of the scientists that I've known so far get GMO information from foreign labs".

Second, news organisations were facing internal obstacles when making global issues relevant to local audiences. Vietnamese journalists were facing increased pressure to produce more copies with less time and resources, leading them to rely on available science materials to meet their deadlines. Particularly when most stories about GMO breakthroughs were from outside Vietnam, journalists simply translated GMO stories from foreign source to fill in their daily science beat. Participants from prestige and well-organised newspapers said their editorial board still exercised editing over international stories while those from smaller newsrooms confessed that their colleagues appeared to copy news from international materials without any linking to local context. C6, a science reporter who has worked for two leading dailies, gave an example: "For news items such as a genetically edited apple that can suppress browning becomes commercialised in the US, Vietnamese journalists just scanned and uploaded the brief content in the science pages. They rarely draw any connection to local contexts. They just treat things on the heels of foreign newspapers."

5.8. Further analysis and primary conclusions

This chapter aims to provide a preliminary outlook into how the debate over GMO was covered by Vietnamese online newspapers. It sought to examine the tendency, dynamics and frames dominated the GMO coverage by quantifying and analysing newspaper content related to the GM event and issues.

While research has given a significant attention to the media representation of GMO, there was limited examination into the case of Vietnam. Yet the sparse literature shows a minimal coverage of GMO in the Vietnamese news media. Although our analysis examines the news content in a limited period, data support the initial insight about the low position of GMO in the media. In-depth interview also shows that journalists did cover GMO, but the topic was unable to maintain the newsroom and audience interest. Placing the modest coverage of GMO in the Vietnam's political and social context which often lack concern and resource for R&D, as well as the current troubling economic status of news industry, it is unsurprising to find

the backseat of GMO in Vietnamese newsrooms. In addition to the low coverage, news about GMO was primarily event-based, often directed by notable events outside the national border. Compared to the persistent debate over GM risks and benefits in the European, American and Japanese media (Bauer 2002, Bauer and Gaskell 2002, Nisbet and Lewenstein 2002, Hibino and Nagata 2006), GMO controversy was a fringe issue in Vietnamese news. Alike most parts of developing world, such as China where GM was not a prominent issue in the media (Wen and Wei 2018), news about GMO only peaks concurrently with remarkable events or sensational issues which attract high public attention. The flashpoint of GMO in the news consolidates the assumption about how a science issue becomes a media story (Neresini 2000). It also reflects the fact that media and the public are hardly interested in a specific issue for a long period (Shih et al. 2008). The media only focus on a certain subject when it receives heavy political attention. For instance, studies on how biotechnology and stem cell research in the US gain, sustain or forfeit media attention found that policy contexts do influence media representation of these scientific controversies (Nisbet and Lewenstein 2002, Nisbet and Huges 2006). Although GM technology and stem cell success were soon acknowledged in the scientific community, the issues remained silent in the mainstream media until they became wider political controversies. Furthermore, the US news media only developed increased interest in these topics when they can be framed as overt conflicts rather than scientific and technical developments. Through the viewpoint of issue attention cycle, it could be suggested that GMO has not been an issue of Vietnamese media interest yet. Although it causes small perturbation in the social sphere, GMO remained within the control of the Vietnamese state. It was primarily framed as new scientific research. Furthermore, as political elites tended to shape GMO as economic growth and international competitiveness, the authoritarian news system was more likely to frame GMO as the key force for national development. The ethical concern which often arises with the realisation of scientific cost and enhance more media attention to GMO were also less common than other frames in the Vietnamese news media.

Existing literature find a polarity in the media attitudes towards GM application in medical system and agricultural production (Bauer 2002, Marks et al. 2007). Our data, in some ways, support this finding with topic about GMO food was more likely

associated with risk. However, opposing to the general media criticism towards GM agricultural products in the Europe, media coverage of GMO plant and seed in Vietnam was more likely associated with benefit. Additionally, while GM technology research and application for improved human health treatment received high media support in the Western media, it was more likely discussed within both risk and benefit in Vietnam.

Most of the story about biotechnology progress were duplicated from foreign sources without contextualisation or relevant comments from domestic scientists. This finding is in line with previous assumption about the domination of international sources, particularly from the developed countries in the non-Western media coverage of science and technology (Nguyen and Tran 2019). The media preference to foreign GM achievements is partly because concern over GMO in Vietnam was still at its early stage. Findings from the in-depth interviews also reveal both the elite and lay public's unfamiliarity to GMO. Apart separate opponent voices on private Facebook groups, GMO was either a largely controversial issue of public sphere or a celebrity issue in the scientific community. According to Vietnam Science Development Scheme, GMO is considered potential solutions to secure the national food security, enhance cultivation productivity and compete the environmental changes. Given the state's priority to biotechnology, mainstream media were more inclined to GMO promising prospects. In addition to external cause, the media oversimplification of GMO benefit, and even risk, was also resulted from the journalists' lack of professional knowledge and specialist reporting skills to critically examine and cover the complicated and uncertain science issues. Instead of doing independent journalistic works, journalists were over-reliant on scientists, who are GMO's proponents, for their GMO investigation. These findings confirm earlier studies about the media largely positive coverage of GMO (Du and Rachul 2012, Ogbogu et al. 2013). However, while Du and Rachel (2012) found none articles in the two authoritative representatives of Chinese mainstream media, *People's Daily* and *Guangming Daily*, expressing negative sentiment to GMO, our study observed a substantial number of articles explicitly manifesting opposing attitude towards the issue (104/335). The rising perceived risks associated with GMO suggests the Vietnamese media potential moving from the pre-problem stage to the alarmed discovery and realisation of the science costs. Yet the account of articles focusing on

negative impact of GMO on social and ethical values was not large enough to cultivate a vibrant controversy about GMO. Controversy was still uncommon frame in stories about GM technology. GMO was widely motivated as a scientific novel which bring exceptional benefits to agricultural economy.

There are a number of limitations in our research that future studies should take consideration. First, the chapter only examined articles published in 2017 and 2018, which is unable to represent the trend of GMO coverage across the recent years. Furthermore, the frames were adopted from Bauer et al. (1995), Durant et al. (1998), Nisbet and Lenwenstein (2002) may be relatively outdated and irrelevant to media culture in the Globe South. As a content analysis, this study cannot and does not aim to explore the narration and metaphor used to depict GMO. Furthermore, while in-depth interview with science reporters provides several insights inside the newsrooms, it cannot capture the whole process of science news production. Discussions with scientists and other interest groups, such as GMO company or biotechnology activists may give a diversified view about how science news travels through different levels of news representation. It would be potential for a better understanding of how and why science media in developing countries fail to accomplish its critical role that it should hold for development goals.

Chapter 6

CASE STUDY 2: VIETNAMESE NEWS REPRESENTATION OF ARTIFICIAL INTELLIGENCE AND ITS CONTROVERSIES

The previous chapter shows that Vietnamese journalism does cover GMO events and issues, but the coverage is yet substantial and critical. Although both promising prospects and possible dangers were presented, GMO was not framed as a social and political controversy. As the government and biotechnologists, whom Vietnamese media often depend on for source of information, advocate GMO advancements, it is understandable to find a general support to GM applications in news coverage. Sometimes, the coverage was overexcited about GMO benefits for the food security and agronomic or overexaggerated about GMO risks for human health. Much of news showed a lack of critical analysis and investigative report on GM debate. This poor informed reporting fails to improve public perception of and engagement in global controversy. For long-term consequences, it would result in the cessation of science empowerment for development.

As GMO is not a new global controversial issue, it might find hard to sustain the social and media attention. This chapter, therefore, chooses an emerging scientific issue, artificial intelligence, to explore the media framing a nascent science debate. AI is another emerging area of science controversy that bear crucial and direct implications for the short- and long-term future of every country in the world. On the one hand, it brings exceptional benefits for global economy, education, medical treatment, energy, environment and public safety. On the other hand, the cutting-edged AI may cause dreadful consequences on ethical values, human race, job loss and arms race between nations. Considering “the rise of powerful AI will either be the best or the worst thing ever to happen to humanity”, as raised by Professor Stephen Hawking in Cambridge Conference for the future of AI (Saffell 2016) and “AI could be the worst event in the history of our civilization”, as warned by Elon Musk (Thomas 2019), AI is a truly inter-scientific dispute between innovation and disruption. The technology is going very fast but the reaction of governments around the world is slow. Particularly, developing countries, which were more often science receivers than developers, have to strike a balance between applying the innovation or banning AI for its unwanted harms to society. In this context, the media, thus, play a great important role to restrain public overexcitement about AI, inform and alert

citizens and politicians with social and ethical impacts of AI. Any professional media coverage would either decelerate its applications or accelerate its implications. Whether Vietnamese news media succeed in prepare public to the controversies over AI or, similarly to GMO, it failed to bring public to AI updates and to forewarn Vietnamese government about AI consequences? This chapter would provide a snapshot into media reaction to a new science breakthrough that has been changing every aspect of our world sharply. One aim of the present study is to explore potential difference in media framing a prolonged science debate and a rising dispute. By examining how media representation of global controversies in a particular temporal context, it seeks to contribute to the conceptual backdrop of science journalism for development.

This chapter will provide a snapshot about AI and its rise as a global scientific debate. After reviewing the media representation of AI in existing studies, the author will then employ content analysis to identify the major dynamics of AI in the Vietnamese news. Discussion with science journalists will also be used to explore the nature of AI reporting and explain potential obstacles challenging their profession. Positioning online news coverage of AI in Vietnamese socio-political context, the chapter will evaluate and propose several initiatives to enhance the role and function of science journalism for development.

6.1. A glance at artificial intelligence (AI)

6.1.1. Artificial intelligence – The rise of a global issue

In March 2016, the history of artificial intelligence as well as humanity saw a symbolic moment when AlphaGo defeated Lee Sedol, the South Korean professional Go player of nine dan rank, in the Google Deepmind Challenge Match (Borowiec and Lien 2016). Although AlphaGo is developed for narrow purposes, the victory marks a progress for the future impact of machine with general artificial intelligence on human beings. The Go's successors, AlphaZero, which can master the games with nothing beyond the game rules and, especially Muzero, which can master games without any input, were next remarkable evolutions in the development of general-purpose algorithm.

Tracing back to its early history in the 1940s, the notion of artificial neuron model

was gestated by Warren McCulloch and Walter Pitts (Russell and Norvig 1995). However, the concept AI was unrecognised until the next decade, when Alan Turing published a breakthrough paper, proposing the ability of creating a conscious machine. Turing's questions, later acknowledged the Turing test which used to judge the machine's possibility to perform humanlike intelligence, becomes one of the most significant concept of AI philosophy. Five years after the Turing benchmark, in the historic conference at Dartmouth College in the USA, the term AI was officially coined by McCarthy, Minsky and other colleagues. Turing's work and the Dartmouth meeting establish a foundation for the development of AI research in the upcoming decades (Zhai et al. 2020). From 1956 to 1995, AI received a great expectation of scholars and public but also experiences several dawns and "winter breaks" of research. Since 1995, thanks to the expansion of big data and the development of algorithms, AI has grown rapidly and gained profound achievements than it had ever obtained before.

In the beginning of the 21st century, artificial intelligence has been no longer a pure mathematic concept, a science fiction or laboratory experiments. As one of the newest fields in science and engineering, AI has drawn considerable attention from researchers in multi-disciplines. Everyday news pages are inundated with latest AI breakthroughs. Conferences to boost AI profits are flourishing while governments across globe are launching their national strategy to impulse AI (Lee 2018). From automatic car to Apple Siri, Amazon's Alexa and Google Assistant and a wide range of AI applications on medicine, business, education and engineering, AI plays a significant role in shaping our daily practices and the society operation. Despite that it is among the most widely term mentioned in the media and currently involved in a huge variety of areas ranging from the general to the specific, such as mathematical theorems, education, automatic transportation, communication, healthcare system and national security, there is no consensus definition of AI. It is a holistic concept encompassing many areas of academic arenas, from philosophy to physics, of which notion and utility vary according to background and objectives. Depending on the prime focus on the cognition or performance, AI is defined as the attempt to make machine think with mind, "in the full and literal sense" (Haugeland 1985, as cited in Garvey and Maskal 2020), or the ability of machine that executes tasks requiring human intelligence (Kurzweil 1993, Russell and Norvig 1995). In a mixed approach,

OECD and UNCTAD refers AI to the capability of machines and systems to obtain and apply human knowledge, and to undertake intelligent behaviour, including cognitive and physical tasks (ESCAP - United Nations 2017). In another attempt, the British Engineering and Physical Science Research Council describe AI as the ability of computational systems to reproduce behaviours and actions normally require human intelligence, such as: *“learning and adaptation, sensory understanding and interaction, reasoning and planning, optimisation of procedures and parameters, autonomy, creativity, and extracting knowledge and predictions from large, diverse digital data”* (Hall and Pesenti 2017). Based on machine and deep learning algorithms, AI can “receive inputs from the environment, interpret and learn from such inputs, and exhibit related and flexible behaviours and actions that help the entity achieve a particular goal or objective over a period of time” (Faggella 2019). Generally, AI can be understood as the machine capability to understand, learn, adapt and independently imitate complex human tasks. There are four major principles featuring the humanlike intelligence: acting humanly, thinking humanly, thinking rationally and acting rationally (Russell and Norvig 1995, Mueller and Massaron 2018). The definition of AI has changed over time due to the rapid development of technology. Based on its progress, AI can be classified into three categories:

- Artificial Narrow Intelligence (ANI): ANI, which is also termed as weak intelligence or specific intelligence, is developed to fulfil particular focused tasks, without ability to self-expand functionality.
- Artificial General Intelligence (AGI): AGI, which is also known for human AI, full AI or strong AI, is generated to undertake broad tasks, reason, and improve abilities similar to humans.
- Artificial Super Intelligence (ASI): ASI indicates the machine cognitive ability beyond human capabilities.

Figure 6.1 Three stages of AI development (Source: USB)²²

While AIN imitates limited humanlike behaviours and actions, it represents the infant stage of AI. AGI functions the more advanced intelligence, such as problem solving and abstract thinking, manifesting the second stage of AI. The final stage of AI would see the mature of ASI, in which it outperforms human intelligence in all aspects. At the present, while several scholars believe that AI is currently in the transition from the initial to the second stage, in which machine ability become comparable to human being, others believe the logic of asserting AGI in 2020 seemed far-fetched and it still takes decades for AI to equal humans (Bostrom and Müller 2014, Goertzel 2014, Jajal 2018, Davidson 2019, Joshi 2019, Sameer 2020).

6.1.2. Artificial intelligence - A global opportunity and challenge for humanity

Although AI has not arrived its second stage yet, thousands of its achievements are successfully applied in many aspects of human life. Scholars widely agree that AI has become the core driving force for the new industrial revolution, a change agent for dramatic developments in business, healthcare, education, national security, government and societies globally. McKinsey Global Institute report 2017 finds a very fast-growing investment on artificial intelligence research and applications across the world (Chitturu et al. 2017). At the international level, it is estimated that in 2016 alone, technological companies, led by Google and Baidu, spent \$20 billion to \$30 billion on AI's R&D, deployment, and procurement. At the national level, China is one of the foremost global investors in AI's R&D thanks to its strong effect on the

²² Available at: <https://www.ubs.com/microsites/artificial-intelligence/en/new-dawn.html>, accessed 16/6/20)

country's future economic growth. In July 2017, Chinese State Council officially announced a document that resolve to place China as the forefront of AI research and application by 2030 (Mozur 2017). According to Lee (2018), AI is undergoing its "Sputnik moment" in China in which government, investors and entrepreneurs has "ramping up AI investment, research and entrepreneurship on a historical scale". Sharing a similar motivation, in May 2018, UK government releases the Artificial Intelligence and Data Grand Challenge, put AI at the central priority of policy initiative for making UK the leading nation in the AI revolution (Brennen et al. 2018). Other countries in the non-Western world also see AI as the most promising possibility to bring breakthrough changes to development processes in the era of 4.0 industrial revolution.

First, AI brings huge benefits for business operation. It is considered as the most promising new technology that helps reduce operational time and costs, increasing business forecasting accuracy, generating business insight, growing revenue and enhancing customer experiences. Particularly, it increases the productivity of companies which directly interact with the big data such as online ecommerce business, logistic corporation and market research agencies. At the present, not only the big giants Amazon, Ebay, Zalando, Alibaba or Taobao²³ but also emerging ecommerce companies in developing countries, such as Shopee, Lazada in Southeast Asia or Tiki, Sendo in Vietnam are optimising the competitive power of big data to improve their inventory management, drive product recommendation, personalise consumer's experience, automate customer service and formulate the most efficient routes for logistic.

Second, thanks to its ability to process and analyse the big dataset, AI can increase the healthcare efficiency by encouraging human healthy behaviour, enhancing early disease detection, diagnosis and improving medical treatment, research and training. The two well-known AI applications that have had significant contributions to healthcare, are IBM Watson's computer system and Google Cloud's Healthcare app. While IBM Watson can store and review a massive amount of medical data, i.e. journal, symptom, and response, it helps clinician to determine the most appropriate and timely treatment for cancer patients. Google Cloud's Healthcare collects data

²³ <https://gomakebig.com/worlds-top-10-ecommerce-sites/>

from users' electronic health record to help doctors to identify the patterns for illness diagnosis more accurately as well as track, predict signals and recommend a more informed medical treatments for acute diseases make treatment decisions.

Third, one of the benefits that AI brings to the modern era is its impact on newsroom operation. It is now changing the newsroom' business model by empowering the self-learning algorithms to determine the content of and access to news. Thanks to its ability to dig and gather rich information, convert raw data into news outputs, especially straight and multimedia news stories, generate personalised news to readers, detect and eliminate fake news, AI software becomes more popular in The New York Times, The Washington Post, BBC, Reuters and other news agencies around the globe (Underwood 2019). Especially, the emergence of robot journalism enables the newspapers to produce larger quantities of information in shorter duration with lower expense, releasing journalists of daily workload for more focus on higher impact interview and analytical features or investigative, long-form or data-driven news stories.

Fourth, AI-based technologies further benefit education by monitoring and evaluating student progress in real-time, offering automating teacher assistant, interactive training materials, and customised learning syllabus for specific student, simplifying school administrative management with automatic machine or software. Additional applications in energy, environment and public safety and other wide range of advantages reinforce AI's value in global market. AI based-technologies, such as robotics, Internet of things, cloud technology, automobile car, automating knowledge, are expected to reach the top twelve technologies to transform life, business and the world economy, being able to generate up to approximately 21 trillion US dollars by 2025, according to McKinsey Global Institute Report 2013 (Manyika et al. 2013). According Centre for Data Innovation, AI would expand the economic growth of the US and Finland by 2%, Germany by 1.9% and Japan by 1.6% per year (Castro and New 2016).

While it brings huge benefits and hopes for many aspects of human life, researchers, e.g. Stuart Russel (Roux 2016) and Stephen Hawking (Roux and Mollard 2016), warned the long-term unexpected implications for the world as AI is processing much faster than supposed. Other big names, such as, Elon Musk and Bill Gates many

times voiced up their concerns on the unpredicted dangers caused by AI. According to Hawking and his colleague, the side-effect of AI could damage the human race: “Success in creating AI would be the biggest event in human history. Unfortunately, it might also be the last, unless we learn how to avoid the risks”. In the same vein, Musk forewarned the growth of AI is extremely fast that it will outcompete the human management. Compared to nuclear power, “AI is more dangerous”, he added. A survey by Müller and Bostrom (2016) estimated superintelligence will take over general intelligence in the next thirty years. More seriously, experts in the study fear that the development could push humanity into “bad” or “extremely bad” situation. By now, these forewarnings of AI’s danger perturbed the globe when Humanoid Sophia Robot was granted citizenship of Saudi Arab. While the momentous event offered promise for a utopian future in which robots can be highly efficient assistant for human beings, its underlying impacts produced a stir in world opinion and should be controlled. There were reasons for such worries as in the same year – July 2017, a pair of Facebook bots started to exchange messages in a humanlike language that departs from traditional English. Although Facebook immediately shut down the project, the progress of algorithm’ self-taught raises concerns of a dystopian future when machine can communicate with one another — without any human input, and even, take over humans.

While it is still too early for people to understand most of the AI dangers, there are several existential negative impacts that AI makes on human life, such as: the AI-driven unemployment, accident caused by self-driving cars, distortion of human values, etc. Turchin and Denkenberger (2020) refer AI to the global catastrophic risks, which can be classified into three layers: risk associated with narrow AI, young AI and mature AI. For example, the narrow AI can create accident in critical infrastructure, wrong command to robotic army, danger in biotechnology, slaughter-bot swarms, early adoption of untested AI solution, employment and ascending non-human economy while young AI can lead to robot and non-sentient simulations’ replacement of human, human destroy by AI, doomsday weapon for global blackmail, AI’s escape of human and human atoms used by AI as material. Among the far-reaching consequences, ethical issue has confronted public since the start of AI research (Vakkuri and Abrahamsson 2018). The AI trolley problem developed by MIT Media Lab is a typical experiment on the technological violation of human

values. Rather than the apocalypse scenario, the real danger while algorithm system is dedicated the right to monitor personal information, decide the disease treatment, bank loan, job offer or prioritise life of passengers over pedestrians, human over pets, more lives over fewer, put the globe into an unbounded debate. The imminent risk is more intensive for developing countries because the growing adoption of automatic system would displace several jobs that normally require a large amount of labour force. The decisions on ignoring or accepting AI despite its potential adverse effects often pivot upon cost-benefit analysis. Thus, it requires public and states in the South to have appropriate understanding and good governance over AI, ensuring developing countries are not left behind the global development.

6.1.3. The need to study media representation of artificial intelligence

The emergence of AI is reshaping the world. AI is expected to have a heavy impact on global productivity, living standard, equality and many aspects in both short and long-term. It is creating opportunities for developing countries like Vietnam as well as posing challenges to their economic, social and political infrastructures. According to an OpenGov report, AI is prioritised as the key area in Vietnam's fourth industrial revolution strategy. Yet, the country's AI research and industry is rather thin, and fledgling compared to developed countries. Indeed, Vietnam has not found to have a strong ecosystem for AI industry adoption (Dharmaraj 2019). Furthermore, the Provincial Competitiveness Index (PCI) study recently finds that the potential impact of automation on the Vietnamese business will varied upon the service sector operations. While AI will increase productivity and reduce labour cost as well as expand opportunities to the next generation's employees in Vietnam, it will lead to job redundancies in several parts of the market labour force (Malesky 2020). Given that Vietnam is a young developing country which hinge the national competitive competences on low-cost labour resource, it is facing more challenges of job displacement by AI. However, as AI adoption is unstoppable force for not only Vietnam but also global development, it is prudent for the country to develop adaptable policies to advance the benefits and mitigate the harms of AI invasion, utilising the AI efficiency to serve the individuals and society. Failure to do so could result in human inequality, social and ethical violation and human insecurity.

Similarly to other emergent and uncertain scientific advancements, social ignorance

or acceptance of AI often depends on the public's perception of AI and its implication on human beings (Chuan et al. 2019). Yet AI is too complicated and abstract for the general audience, most of their knowledge and concern about AI is directed by the media. The news media, with considerable influence on the way in which science information is perceived, should inform and prepare public in the discussion over AI's prospects and limitations. A shortage, inundation or misrepresentation of AI novelty could distort public knowledge of and behaviour towards science policy (Ouchchy et al. 2020). The role of media in bridging lay people and science community, public opinion and policy makers' viewpoint in AI debate is particularly vital for developing countries because these countries are more susceptible to AI possible threats. Yet initial reports find that media tend to fictionalise AI, either overwhelmingly hype its power or speculate the catastrophe that AI might bring (Brennen et al. 2018). For example, Vietnamese newspapers often depict AI as "a key development trend, with big effects on all aspects of life" (VietnamNews 2019). Research accessing the media coverage of AI, thus, is essential to understand the mechanism formulate public attitudes and reactions to this global controversy. However, there has been scarce empirical research on how media conceptualise AI, especially in the Global South. This chapter therefore employs the Vietnamese news coverage of AI to provide an overview of how AI is perceived and framed in the developing countries. It aims to provide an insight into the evolution of Vietnamese newspaper coverage of AI during the last two years and identify the role media in AI communication, elucidating how media define, present AI and what AI means to publics.

6.2. The emerging scholarly interest in news coverage of AI

In the beginning of twenty-first century, among the novel scientific innovations, there is a sense of research growth in media reflecting nanotechnology (Friedman and Egolf 2011, Guenther et al. 2015, Strelakova 2015) whereas little attention is paid to media reporting recent scientific controversies until such issues become widely concerned in the international sphere. Similar to the birth of Dolly the sheep, the defeat of Alpha-Go to a human in the game of Go has brought AI into the public centric attention (BBC 2017). Thus, as in the cloning case, it is reasonable to expect the rising media interest in AI, given the public attention to technology as well as its possibility to help mitigate economic pressures of the news industry itself. Indeed,

despite the overall decline of science in the news, AI is becoming a prevalent topic in the mainstream media (Brennen et al. 2018). Yet studies into news media representation of AI - a global advancement which is transforming the way we work, live and identify ourselves in unprecedented directions - is at its early stage. By 2017, media research show their almost apathy to news coverage of AI. Of less than ten studies tracing the evolution of AI in the media discourse, most have been conducted in the last two years. For now, Reuters Institute for the Study of Journalism research on UK media response to AI (Brennen et al. 2018), Chuan et al. (2019) analysis of American newspapers framing AI, Kirkpatrick (2019) comparative study on AI coverage in the US and UK newspapers, Zhai et al. (2020) and Sun et al. (2020) reviews about AI in the US and UK press, Ding and Kong (2019) observation on media construction of AI in China, Ouchchy et al. (2020) approach to ethical issues in AI news headline and are the very first systematic research into media reportage of artificial intelligence. These studies reflect the interest in how media in the AI superpowers, such as China, the UK and the US, respond to the technology. Critical viewpoints from the middle and low-developed countries in the AI race are absent in the media research literature.

Furthermore, although the late 2010s observes a growing scholarly interest in the AI news, research primarily focus on the portrayals of AI in the press. There is scarce research examining the process organisations and individuals who create media content perceive, select and present AI stories, their mutual relationship as well as the obstacles and constrains challenging journalism operation. As argued in Chapter 4, news representation is a process that an entity is presented in the media by a mediated linguistic system. It consists both the portrayal of reality and the procedure of such presentation. A comprehensive interpretation of how and why AI is constructed, thus, exposes problems that could explain critical issues in media representation of AI. Yet the missing understanding of AI news production pose a gap in the field of research. However, several insights about the media representation of AI could be gathered from this fairly scarce literature.

First, these studies consistently find an overall rising media coverage of AI in the recent years. As AI is expected a major force for British industry and health care, and the UK government plans to make UK the leading country of the AI and data

revolution, it receives substantial attention from the UK mainstream media despite the general decline and even elimination of science and technology reporting across the news outlets (Brennen et al. 2018). Kirkpatrick (2019), Sun et al. (2020) and Zhai et al. (2020) reinforce this initial result that UK newspapers are developing their coverage of AI during the last five years. Among the analysed broadsheets, the Guardian comes first in the number of AI stories which mostly focus on film and game commentaries (Kirkpatrick 2019, Sun et al. 2020). A similar upward trend is also shown in the Dutch press (Vergeer 2020). In the study of AI topics and trend during 2000 and 2008, the author discovers that the newspapers in the Netherlands increased their stories about AI since 2014. In the US, AI reporting has remained muted until recent years (Fast and Horvitz 2017, Chuan et al. 2019, Kirkpatrick 2019, Zhai et al. 2020). An analysis over 30 years of news articles in The New York Times by Fast and Horvitz (2017) shows a wake up of media reporting on AI in late 2009, following three hibernated decades. While the authors are unsure about the originality of this sudden spike, they find the dramatic rise occurs right after the renaissance of “neural network”, “deep learning” and their applications. Chuan et al. (2019), Sun et al. (2020) and Zhai et al. (2020) are in accordance that the early stage of American AI sees a scant media interest in covering topics related to its advantages and drawbacks. However, there is a growing intensity of the coverage from 2015 onward. The rising US media coverage of AI, according to Kirkpatrick (2019), is partly caused by several noticeable AI milestones and remarked events, such as Stephen Hawking’s notification of AI threats to human or the historical pass of “Eugene Goostman” chatbot in Turing Test. The findings support previous studies about media attention to the cloning of Dolly the sheep (Priest 2001) and biotechnology (Nisbet and Lewenstein 2002) that media tend to be event-framed, peaking in response to major scientific announcements. Based on this assumption, it is supposed for a similar ascending trend in the Vietnamese newspapers coverage of AI.

Second, in term of media focus, McKinsey Global Institute report on the possibility and challenges AI could make in industry indicates that most of the AI news is coming from AI companies (Bughin et al. 2018). This preliminary statement is consolidated by Brennen et al. (2018) empirical study on UK press representation of AI that there is an overwhelming domination of industrial references in AI news. A

majority of news articles across six sampled mainstream UK news outlets associate with industry products, ranging from smart phone, running shoes to robot and neutral preservation. Many stories focus on the entrepreneur AI related strategies and initiatives, including start up, investment, mergers and acquisitions. In addition to the preference to industrial promotional events, such as the Consumer Electronics Show or the Google annual developer conference I/O, media particularly pay a great attention to the high-level industrial agents in AI companies. The study exemplifies that nearly twelve percent of articles report Elon Musk related stories. The salience of business topics is also found in the US, which one third of AI stories reported in the five most wide-spread dailies from 2009 to 2018 are about economic concerns (Chuan et al. 2019). The equivalent priority of British and American mainstream media to AI industry and trading is presented in Zhai et al.' study (2020) that stories about company, such as Apple, IBM, Microsoft, Google and Facebook, are the most frequent AI topics in CNN, USA Today, The Guardian, The Washington Post and The New York Times. These industrial tech giants are also major objects covered in the Dutch press (Vergeer 2020). The media concentration on AI leading companies, such as Facebook, Twitter, as well as their involvement and effort to fight fake news and misinformation, according to Vergeer (2000), is a result of the 2016 US presidential election. The discussion over AI companies and its commercial value further dominates media in the South. Regardless the impact of cultural and political divergence on media reporting, Ding and Kong (2019) find that American and Chinese share a similar concern on the economic aspect of AI technology, for example intelligent machine, commercialization of machine and Internet companies.

Third, as a result of the dominated industrial and business topics, CEOs or other senior managers are mostly sourced by the press, compared to a smaller reference of the academia and the governmental officers during the same time. Brennen et al. (2018) shows that industry indexes for 33% of unique sources across UK news outlets. The contribution is nearly double the scientific sources and six times higher than state and political sources. Notably, company CEOs are mostly quoted among the industrial agents. The source associated with business also predominates the US media, taking approximately two thirds of the most frequent citations in the five US news outlets in the last decade (Chuan et al. 2019). Following the industry-connected source, scientists and research institutions are the second favourite

sources in both American and British journalism (Brennen et al. 2018, Chuan et al. 2019). Particularly, there is a slight increase in the number of American articles citing academia community in the period between 2009 and 2012 (Chuan et al. 2019). Yet the authors give no reason for such short-term rises of academic sources. Like the Chuan et al. (2019), report by Brennen et al. (2018) lacks empirical data explaining the Guardian is the only UK newsroom prioritising academic to industrial citations. In another study, Zhai et al. (2020) suggest that the AI reporting often includes reference to commercial institutions and academic community revealing a successful combination of science and business. Given the salience of business and technology sources, it is not surprisingly that the media are in less favour of state authority. However, some research reveal that AI coverage is political oriented in several ways. Chuan et al. (2019) discover from 2015 onward, American reporters quote more governmental agency. Moreover, UK right-wing news outlets tend to frame AI as economic and geopolitical issues while left-wing outlets emphasise ethical aspects, such as discrimination, algorithmic bias, and privacy (Brennen et al. 2018). Meanwhile, Chinese coverage of AI is set by the stage agenda, heavily supporting governmental viewpoint on AI advancements (Cui and Wu 2019). The salience of state sources in Chinese AI news originates from Chinese journalism norm to promote the national main policies. With this in mind, it might be anticipated that Vietnamese journalism – which experiences almost identical cultural, social and political conditions as China – would primarily base its AI reporting on governmental sources.

Fourth, in contrary to the anecdotal criticism of media sensationalisation of AI risks, the literature reveals newspapers tend to frame AI as benefits and utility rather than the limitations of technology and its entailed threats (Brennen et al. 2018, Chuan et al. 2019, Ding and Kong 2019, Kirkpatrick 2019, Zhai et al. 2020). AI is usually portrayed as a possible solution to a wide range of human issues despite existing uncertainties over its potentially negative effects. It is also constructed as a change agent bringing revolutionary development across sectors, from industry to healthcare system (Brennen et al. 2018). However, it is found that news outlets incline to magnify AI potential advancements by emphasising on the intention of AI applications rather than its existing functions. However, the research does not take the why of such benefit -favoured themes into account. Cui and Wu (2019), on the

other hand, shift the Chinese newspapers tendency to portray AI in a positive light on the government's overarching influence over media. The authors indicate that both Chinese traditional and digital media must report major issues in favour of the state policies. Since Chinese government identifies AI as a decisive force for the national development, news media duplicate the political agenda, setting AI as positive and advantage. Ding and Kong (2019) elucidate the Chinese state control on media by analysing the news coverage of AI in The New York Times and China Daily. While the former is predominantly pessimistic about potential threats of AI technology, e.g. automatic cars, robotic and AI weapons in Chinese military, the latter, in contrast, adopts a more positive viewpoint towards AI innovations and manifests limited concern on the possible dangers caused by AI (Ding and Kong 2019). The authors augment Cui and Wu' (2019) stance on the Chinese media pro-government strategy that the significance of Chinese news to AI prospect may result from a range of indicators, not only the political authority, but also the national interest and strategy, socio-economic, cultural and historical conditions.

Although the media predominantly frame AI as benefits, research also notes that the number of articles associated with AI-risks is increasing in the recent years (Chuan et al. 2019). Especially, while AI strengths are mentioned more often than drawbacks, the shortcomings of AI are discussed more specifically in terms of AI misapplication, AI ethics, loss of job, privacy, unforeseen risks, menace to humanity, escaping way, AI limitation. Additionally, economy topic is more likely covered in stories that mention benefit only and less likely in articles that associate with risk only whereas science and ethic are more likely to presented in stories discussing risk only (Chuan et al. 2019). This finding is further reinforced by Zhai et al. (2020) that topics closely associated with moral dilemma, such as AI abuse in military, weapons, security, gaming, human right, job elimination, are frequently framed with negative sentiment. The researchers expect a growing media attention to AI detrimental consequence will expand the social discussions on this life-consequential technology. As opposed to the media overall favour to AI benefits in the UK, US and China, the newspapers in Netherlands tend to balance the positive and negative impacts of AI on human beings. Particularly, national newspapers and popular newspapers show more negative while religious and economic oriented press are more likely to frame AI with positive viewpoint (Vergeer 2020).

Finally, given that ethics beyond AI are more likely to be discussed in stories mentioning risks, it is presumably that there is an overreaching critical attitude towards emerging AI moral problems. Indeed, as opposed to the media coverage of neurotechnology which skews into a predominantly supportive or negative sentiment (The Royal Society 2018), study in English written news headlines expresses a dominance of balance/ neutral tone in articles reporting ethical issues surrounding AI (Ouchchy et al. 2020). The authors suggest that aside from the profound benefits to many people, the foreseen consequences of AI, caused to others are abundant. Accordingly, news media fulfils its vital function in science communication by providing an impartial coverage of both positive and negative sides. Moreover, since the effect news can make on public perception, the media coverage of AI ethics could influence the AI implementation on society. Journalism, hence, is expected to present an in-depth analysis about ethical controversy caused by specific application of AI. Yet most of newspapers are found to focus on ethical dilemmas and moral questions associated with general AI topics rather than particular deployment of AI. Specific types of AI are usually used as examples in a broader discussion about ethical implication arising from the development and implementation of AI technologies (Chuan et al. 2019, Vergeer 2020). Chuan et al. (2019) emphasise that most of articles in The New York Times lack thorough and intensive analysis on each specific ethical problem regardless the recent increase attention to AI ethics. Ouchchy et al. (2020) suggest that the shallow articles are written by reporters who have inadequate understanding of AI or moral standards. These studies are initial attempts concerning about AI ethics in the news. However, the published literature are separate and superficial, as compared to the pervasive dispute over AI ethical issues, which makes the topic the most immediate global concern (UNI Global 2017), and public opinion of moral panic is framed and flamed by the media (Goode and Ben-Yehuda 2009).

Generally, despite its near ubiquity and potential to alter individual daily life, social infrastructure, national and international relations as well as ethical standards, there has been relatively little literature published on the media representation of AI controversies. The media framing of uncertainty around AI's potential risks and benefits has been an ambiguous phenomenon to many. It has recently become an emergent subject in social sciences in the West whereas there has been lack of viewpoints from the non-Western world. Thus, it is demanding for increased interest

in media study of AI coverage in developing countries for a more comprehensive and independent views on the capacities, promises and problems of global science controversies for the future of any country in the Global South.

The gap in literature proposes us to approach Vietnamese news coverage of AI to explore how an emergent science controversy travels across the globe. Artificial intelligence was chosen as the key global scientific controversy because it is ‘deeply involved in the relationship between mass media, the public and policymakers’ (Nguyen and McIlwaine 2011). It brings hopes along with often underestimated threats to many aspects of human life. It is an ongoing issue that any progress or failure could have prompt results in the sustainable development. However, the media coverage of artificial intelligence, which has long-term implications both physical and moral values, has not been examined yet. This study is one of the first to discover how it is portrayed as a controversy in the media, expected to allow the author to generalise nature and nuance of media representation of global scientific controversies in developing countries.

The key research question is developed from **RQ3 “How are global science controversies represented in Vietnamese news media?”** is:

RQ3b: “How are the controversial socio-economic risks and benefits of AI represented in Vietnamese news?”

- *RQ3b1: How salient are controversies around AI issues and events are presented in Vietnamese media?*
- *RQ3b2: How are AI controversies selected, framed, sourced, and evaluated in Vietnamese media?*

Placing the study’s in the still sparse literature on science journalism in developing countries, the study discusses their implications, with a focus on the critical role of science journalism for sustainable development.

6.3. Methods for this chapter

As presented in the methodological approach of chapter 1 and chapter 5, content analysis was used along with in-depth interview to explore the trend, dynamic and characteristic of AI in Vietnamese news.

To assess the coverage of global scientific controversies in Vietnamese media, we employed Google database to search for AI article from 01/01/2017 to 31/12/2018, using a simple Boolean key words: “dữ liệu lớn” (big data in Vietnamese), “big data”, “cách mạng công nghiệp 4.0” (4.0 revolution), “trí tuệ nhân tạo” (artificial intelligence in Vietnamese), “artificial intelligence” and “AI” (acronym of artificial intelligence) to seek for articles which were written in native language and from the local websites. The use of the English-language search terms was necessary as news articles in Vietnam often use them in their body for explanation purposes. Using Google News and keyword searching technique, the study collected 1609 samples of AI. After deducting of duplicated results, our research came up with the total amount of 1228 AI stories. The population size of AI stories (which was triple the number of articles about GMO), was too large for our limited financial and time resources. Thus, we decided to reduce its quantity, using the systematic sampling technique. The reason to choose systematic random sampling was its simplicity and periodic quality. A sampling interval $k = 3$ was chosen so as the study could achieve a relatively equal number of AI stories compared to the number of GMO stories found in chapter 5 (401 samples). The sampling started by selecting the first case collected in 2017. Finally, we obtain a total of 454 stories representing the Vietnamese news coverage of AI in the sampling period for the full analysis.

Each newspaper story was treated as a unit of analysis. The coding procedure was presented in chapter 5. Most of the variables are similar to those used to analyse the news presentation of GMO. For the variable “topic” which refers to what the story is about, the coder was asked to choose one answer among the provided AI topics. In the data analysis, several variables that were listed in the coding book were combined together or added to the variable “others or unclear” because they were rarely found in the data. The combination was further based on the similarity or closed relationship between variables. For example, in terms of “topic”, “Human resource in industry and service” was added to “Business and Finance”, “Transportation” was merged to “AI in general and Others”. In terms of “theme”,

“New AI research” was combined with “AI research process” to make the new variable “AI research process and new achievement”. Similarly, “AI debate” was added to “Public perception of AI”. Regarding the “frame”, the three frames adopted from Bauer et al. (1995), Durant et al. (1998), Nisbet and Lenwenstein (2002) “Pandora’s Box”, “Run-away” and “Long-way away” were compounded to create the new frame “disaster” whereas “Ethical concern”, “Nature/ Nurture” and “Globalisation” were added to “Others or Unclear”.

Particularly, risk and benefit frames, a crucial variable that navigates public opinion on emerging technologies (Chuan et al. 2019), were coded in three steps. First, the articles were identified as discussing “both risk and benefit”, “benefit only”, “risk only” or “neither risk nor benefit”. Second, when either a risk and/or a benefit was mentioned, it was analysed in terms of specific types, including laboratory, economy, social issues, ethical issues, health and medical issues, environment issues, mixed-types and others or unspecified risk/ benefit. Final, the mentioned risk and/or benefit was coded for how intensity and specificity the risk and/or benefit was discussed in the new article using a 5-likert scale. Furthermore, in order to measure the reporter’s explicit attitude towards AI event/ issue, the coder chose one of the following variables: “favoured”, “opposed” and “neutral”. The common discourse elements such as: *should apply, recommend, agree, encourage* or focusing on the AI benefits were coded as favour of AI. On the other hand, stories referring to discourse of *should not apply, disagree, opposed to* or emphasising the AI threats were added to opposing attitude. The discourse that focusing on *more research should be conducted in the future* or concentrating on fact or information referred to the neutral sentiment.

Along with the researcher as a prime coder, a second coder, who has a BA in journalism, was hired for the coding activity. The second coder was trained in four weeks how to interpret the coding frame before taking part in a preliminary coding to check the correspondence rate between the two coders. Both coders independently co-coded a randomly selected 120 samples deducted from the dataset to establish intercoder reliability (approximately 30%). We used ReCall online tool at <http://dfreelon.org> to calculate the inter-coder reliability coefficient of all variables. Until the Krippendorff’s alpha reach an initial level of agreement for every variable of

at least 80%²⁴, the remaining samples was divided for the two coders to code independently. All data was managed and analysed using the data analysis package SPSS. Descriptive statistics, crosstabs as well as association tests and cluster analysis were used to analyse the data. Besides, some qualitative data, including important words or sentences from typical samples was recorded to help illustrate and support the quantitative content analysis result if necessary.

Table 6.1. Reality test for AI

Variable	Krippendorff's alpha
Publication	100
Date	100
Length	100
Authorship	92.1
Genre	94.2
Type of headline	87.9
Tone of headline	85.8
Types of lead	89.7
Tone of lead	85.7
Section	90.8
Supplementary materials	100
Readers' comments	100
Topic	86.1
Theme	84.1
Frame	86.6
Type of coverage	94.9
Type of controversy	87.0
The presence of risk and benefit	88.3
Type of risk	91.9
Type of benefit	93.1
Intensity of risk	87.3
Intensity of benefit	80.4
Specificity of risk	88.2
Specificity of benefit	82.1
Locality of the event	95.8
Localisation	100.0
Source of original material	95.5
Source of translation	100.0
Number of sources	90.8
Type of 1 st source (direct/ indirect)	100.0
Role of 1 st source	95.3
Origin of 1 st source	80.6
Type of 2 nd source (direct/ indirect)	100.0
Role of 2 nd source	91.8
Origin of 1 st source	84.1
Metaphor headline	93.2
Metaphor lead	85.7
Metaphor body	83.5
Metaphor last paragraph	100.0
Explicit stance	89.4
Solution	100.0

²⁴ The acceptable percentage is over 75%

Aimed and object explained	100.0
Methodology explained	100.0
Result explained	100.0
Theory explained	100.0
Strength and limitation explained	100.0
Funding	100.0

6.4. Generally growing media attention but predominantly event-driven coverage

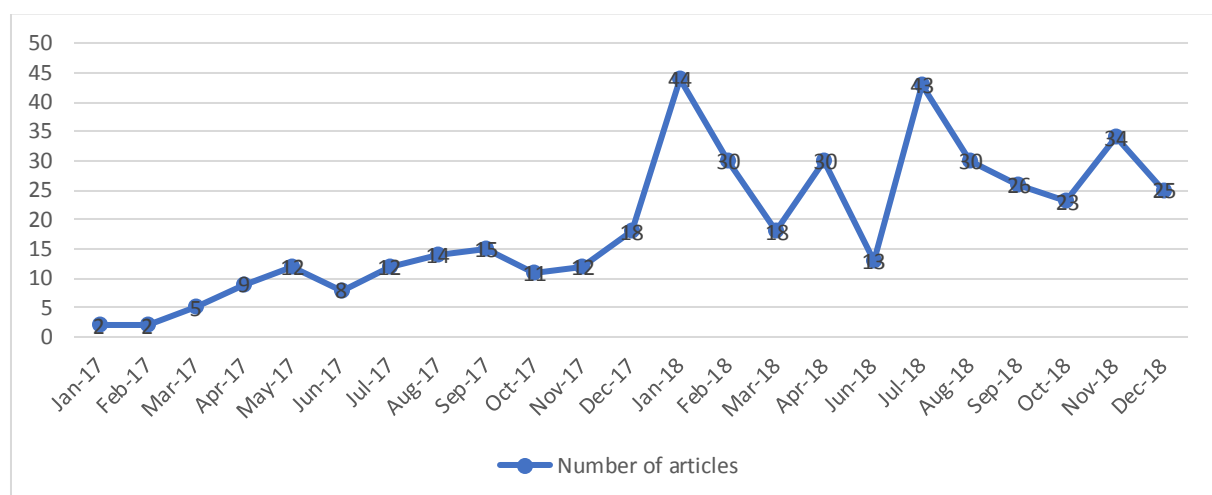
Against the current backseat status of science in the newsroom, AI has received a great attention by Vietnamese news media. Although the study limited sampling period in 2017 – 2018 which could not generalise a volumetric trend of media coverage of AI over the recent years, compared to the number of news articles about GMO (401 articles – see chapter 5), AI was more frequently reported with 1228 articles found in the sampled years. On average, there were more than 51 stories of 88 publications published each month. After a deduction from 1228 collected samples to 454 items (as presented in the above method section), the study found that the number of articles published in the year 2018 was nearly three times higher than 2017 (334/120). Moreover, while 2017 saw an overall upward trend in the media coverage of AI, the data revealed a relative fluctuation in the number of articles about AI over 2018. However, the latter year showed the two peaks in media presentation of AI in January (44) and July (43), respectively. As the latest human achievement, AI technology has been quickly acknowledged as a key driver of Vietnamese fast and sustainable development. For example, Decision No. 66/2014/QĐ-TTg by the Prime Minister stipulates that since 2014, artificial intelligence is among cutting-edged technology that the government's commitment to give priority to²⁵. Subsequently, the Prime Minister's Decision No.16/CT/TTg of May 4, 2017²⁶ confirms AI technology as one of the breakthroughs and key technologies in the Vietnamese 4.0 industrial revolution. Accordingly, it was often articulated by The Prime Ministers and senior governmental officials as the leading force for the

²⁵ Mr. Nguyen Tan Dung (Term 2006-2016)

²⁶ Mr. Nguyen Xuan Phuc (Term 2017 – present)

national development. Particularly, the key words “AI” was frequently linked to “4.0 industrial revolution” in their speeches and statements on socio-economic evolution, making AI the most attractive and worthwhile issue for the news. On this account, AI coverage often rode high on the media agenda across several specific weeks or months in correspondence to the latest announcements of politicians or regulatory bodies, the leading edged scientific news from foreign scientific institutions, the public release at a scientific meeting or the occasional science conference. For instance, the media significantly rising attention to AI in January 2018 stemmed from the enactment of state resolution to impulse the development of AI in the upcoming year. In accordance with the discussion on state policy, news media in the starting month of 2018 also showed their interest in alaysing and estimating the trend of AI from January onward. Likewise, its accession in July 2018 was resulted from the remarkable event that Sophia, the first robot granted human citizenship, attends the Industry 4.0 Summit and Exhibition held in Hanoi on July 2018. **Figure 6.2** also illustrates another notable media focus on AI during November 2018 due to the breaking news that China's Xinhua agency unveils an AI news presenter and Chinese government runs a program to recruit the most intelligent high school students to train them become the world’s youngest AI weapons scientists.

Figure 6.2 The monthly media coverage of AI



The number of articles about AI was allocated unevenly in the searched newspapers. 61.4% of the 88 news publications in the analysis reported under five

articles during the two sampled years (data not shown). *Dan tri* dedicated the most extensive coverage to the issues of AI (30 articles), followed by *Tuoi tre* (20 articles) and *Zing News* (19 articles). *Viettimes* (17 articles), *GenK* (16 articles), *Vnexpress* (16 articles), *Bnews* (16 articles), *VOV* (15 articles) *Tia sang* (14 articles) were among the newspapers that reporters manifested a substantial concern on AI issues. While *Tuoi tre*, *Zing News*, *Viettimes*, *VOV* and *Vnexpress* are general editions, *Dan tri*, *GenK* and *Tia sang* are more-science-focused newspapers that often give a priority on science and technology reporting. For instance, *Dan tri* identifies its mission to enhance the intellectual standards of Vietnamese people, *GenK*, developed and managed by Vietnam Communication Corporation (VCG), is the executive information portal for IT, games as well as science and technology, and *Tia sang* is the specialist science and technology magazine by the Ministry of Science and Technology. The findings also showed a more notable attention to AI risks and benefits of *Bnews*, the economic and financial news site by Vietnam News Agency, than other newspapers with the larger circulation or higher page views and widespread influence on public, such as: *Nhan dan* (1), *Thanh nien* (9) and *Vietnamnet* (12). The favour of business newspapers to AI suggests a tendency of media to concentrate on the economic aspect of AI and a successful association between science and business.

Despite the emerging media interest, news coverage of AI tended to be superficial and episodic. The lack of critical reporting is reflected in several aspects. First, **Table 6.2** shows that most stories about AI were event-oriented, focusing on the moment, single case study or providing a person-central story and a snapshot of “what”, “when”, “where” happenings (68.7%, N = 312), while those that are more issued-driven and contextually analysed took a smaller contribution (31.3%, N = 142). Episodic frames often showcased specific events, particular examples of AI advances and applications, such as: a new AI built-in mobile device or electronic appliance, a progressive step of self-driving car, instant machine translation, or promising result shown in an AI research.

Particularly, even though it was assumed that science-focused newspapers and general newspapers manifested their varied interest in AI issue, a chi-square test of independence between two types shows that there was no statistically significant

difference of subject focus and the prominent framework forming the story ($X^2(1, N=454)=, p>.05$). Both newspapers that gave more focus on science and technology, such as *Tia sang*²⁷, *Khoa hoc va Phat trien*²⁸ and *ICT news*²⁹ and general newspapers, such as *Tuoi tre*, *Thanh nien*, *Tien phong*, tended to frame AI episodically with coverage emphasising on specific examples of AI advances and applications. As shown in **Table 6.2**, event-emphasised coverage took 69.9% of general newspaper whereas it contributed 68.4% of AI stories in science focused newspaper.

Table 6.2 Type of coverage by type of news outlets

	Total N=454	Gen. newspaper n= 361	Sci. newspaper n=93
Event-oriented	68.7	69.9	68.4
Issued-oriented	31.3	30.1	31.6
$X^2=0.07, * p >.05$			

While most of coverage was event-oriented, news content was usually presented in form of brief and straight news. **Table 6.3** reveals a domination of straight news (59%) to feature article and other in-depth formats (31.2%). Opinion/ editorial and interview, were infrequently used to discuss and analyse the long-term implications of AI on global development. Regardless of online newspapers' capacity to offer an unlimited space for news presentation, this study found a small number of articles taking the full advantages of digital platform to broaden and enrich science content. There was a shortage of AI stories presented in video, gallery or long-form/ mega/ multimedia story and the like. For instance, although hypertext and link which provided the main body important context and background, linking the discussed issues to the beyond and behind stories (Stray 2010), they were not commonly used in Vietnamese online news. Of 454 analysed articles, only 21.2% offered subsidiary information by inserting hyperlink and text. Furthermore, local journalists rarely used video (9.9%), diagram/schema/map (7.3%) or audio (1.5%) to enrich the content (data not shown).

²⁷ <https://tiasang.com.vn>

²⁸ <https://khoahocphattrien.vn>

²⁹ <https://ictnews.vietnamnet.vn>

Table 6.3 Genres of AI news articles

Genres of publication	Frequency	Percentage %
Straight news	268	59.0
Feature	114	25.1
Opinion/ Editorial	10	2.2
Interview	11	2.4
Gallery	7	1.5
Others	44	9.7
Total	454	100.0

As a result of the event orientation, there was a lack of critical analysis about AI. A large number of stories tended to concentrate on frontline science with its new achievements. Journalists often used sensational terms describing “breakthrough” or “disaster” to excessively celebrate the benefits or exaggerate the risks of AI, rather than going beyond the science caveats, exploring weight of evidence and code of research ethics. As shown in **Table 6.4**, reviewed articles rarely presented AI events and issues with an efficient evaluation of the scientific rigour behind them. Only 10.8% of the sampled stories was found to introduce the research aim and object whereas only 6.6% of the data explained how the research was conducted. Science strength and weakness, limitations or flaws were presented in only four articles while research finding explanation was detailed in on two pieces. Particularly, research funding, which is helpful to uncover possible conflict of research interest was seldom reported. Of 454 analysed articles, only one mentioned some kinds of financial, personal support or ideological involvement that might affect the research at stake.

Table 6.4 Mentioned science aspects in AI stories

Scientific aspect	Percentage
Aim and object	10.8
Methodology	6.6
Result explanation	0.4
Strength and Limitation	0.9
Funding	0.2

The uncritical coverage additionally manifests in the lack of multi-source stories about AI. Of the 454 stories, only 40% (**Table 6.8**) have two or more than two sources of quotation. Although it is hard to say that a mix of news sources would

enhance critical science journalism, it could at least avoid factual biases. Single source reporting is unable to provide a neutral view, or even promote prejudice, on the issue. As a result, it would drive audience to the reporter's desired assumption or conclusion.

From the in-depth interviews, our correspondents suggest that the increasing media attention to AI is partly because AI research and its commercial applications have been making considerable impacts on the world's markets, industries, governments and individuals. Participant B1 told that "2017 can be seen as the year of artificial intelligence. Our newspaper has chosen AI as the key topic for our special new year issue". AI's widespread influence on economic, social and political norms is widely acknowledged in Vietnam when senior politicians frequently highlighted AI as the major force of the national development. It is thereby AI becomes the most prominent science issue in Vietnamese newspapers. Another interviewee, B3 compared AI to other S&T issues "AI and industrial revolution 4.0 attract a significant state and media attention".

However, it is agreed by many interviewees that despite the rising coverage, most AI stories are superficial. According to A2, a science editor who used to be a senior lecturer in journalism, Vietnamese media tended to introduce AI achievements and its beneficial applications to daily life in form of straight news and episodic coverage. Occasionally, there are a few in-depth stories analysing AI negative impacts on human beings, i.e. job loss, privacy violation, high-tech crime increases. However, "the majority of AI coverage is about what happenings rather than how and why of such happenings", he added. "AI is too new for Vietnamese journalists to have a proper understanding and critical reporting about. I myself try to deepen my knowledge about AI but it takes times", A2 explained. In fact, Vietnamese media are often lacked critical in science reporting. Due to several internal and external obstacles, most of the time, science journalists are more likely to celebrate science benefits rather than scrutinizing science caveats and its implications on individual and national development. The next section will provide further evidences for this tendency.

6.5. The salience of economic prospect

As a large number of AI practical applications have been adopted in different areas of our daily lives, media coverage of AI comprised a variety of topics, including AI in general. However, our analysis revealed a domination of articles which major subject was about AI in business and finance. More than half of reviewed samples (45.6%) indexed to industrial concerns and commercial products of AI, such as AI built-in smart phone, automatic cars, chatbot and AI-integrated computer programme to increase work productivity. Many of them were in the form of disguised news – i.e. advertorials or public-relation pieces whose sponsors are not identified. For example, many of the online newspapers in the sample ran a “story” about the launch of an AI-enabled anti-virus software programme by BKAV in January 2018 without labelling it as an advertorial. Their almost homogenous content, which was in fact duplicated from the company’s news announcement, presented information to promoting commercial product instead of informing and improving public knowledge about the significance and necessity of AI to their daily life. It was often described as an invisible feature to improve the quality of smart appliances. Samsung, LG, OPPO were among those companies of which AI-built devices, such as TV, fridge, and phones are regularly reported in the media. Notably, this kind of industry-led news were mostly placed in “Science and Technology” section, in preference to “Economy, Finance and Business”. By this, AI commercial products was disguised by discourse of scientific progress, possibly misleading audience about the value of AI benefit. The salience of industry products and initiatives outreached the story about AI in “Education” which contributes about 7.5%, and “Gaming and Entertainment”, accounting for 6.4% of news pegs.

Table 6.5 The major topics, themes and controversies of AI articles

	Number of articles N=454	Percentage (%)
Topic		
Education	34	7.5
Business and finance	246	54.2
Hospital and medical treatment	11	2.4
Gaming and entertainment	29	6.4
AI in general or others	134	29.5
Theme		
Scientific process and achievement	48	10.6
Applications and implications	31	6.8
Policy and legislation	61	13.4
Trading and industry	192	42.3
Public perception	45	9.9

Others or Unclear	77	17.0
Controversy		
Intra-controversy	3	0.7
Political controversy	14	3.1
Economic/financial controversy	14	3.1
Environmental controversy	0	0.0
Social controversy	7	1.5
Ethical controversy	5	1.1
Medical controversy	0	0.0
Multi-controversies	24	5.2
No-controversy	387	85.2

In addition to prime topic covered in the news stories, **Table 6.5** shows nearly half of theme implied in the reviewed articles were frequently involved in “Scientific and technological trading and industry” (42.3%). It was followed by concern on “Scientific and technological policy and legislation” (13.4%) and “Scientific research process and new achievement” (10.6%) respectively. Just 6.8% of the corpus, or 31 articles across more than a hundred news outlets in our study, delivered message about AI dilemmas whereas 9.9% (45 articles) concentrated on public understanding and engagement in AI controversy. This finding is equivalent to the smaller number of sampled stories focusing on debate over AI than those disregard AI as a controversial issue (14.8% - 85.2%).

In order to explore the different approach that science-focused and general newspapers employed to present AI, a chi-square test of independence between two types of newspapers and the primary topic was run. The data show a statistically significant difference between general and science-focused news sites and the major science topic mentioned in the news story $\chi^2(4,454)=9.94, p<.05$). However, the difference was modest: as revealed in **Table 6.6**, both general newspapers and science-focused newspapers gave a preference to AI in general and its involvement business activities, i.e. developing marketing strategy, magnifying sale target, building automatic maintenance, managing manufacturing process and improving customer experience. The main difference was found in the topics of education and health care treatment. While general newspapers were more likely to analyse how AI was transforming the way people around the world teach and learn, they were less likely to discuss several in-depth medical topics, such as: AI machine to assist doctors, surgical robot, AI symptom checker or AI. On the other hand, newspapers

featuring science and technology, tended to give stronger emphasis on AI's growing impacts on hospital and medical treatment or gaming and entertainment. Especially, results found that *Dan tri* and *VnExpress* cover a wider range of topics (all five analysed topics) than other newspapers. Majority of the hundred remaining newspapers limited their interest in one to three topics. Particularly, AI performance in "Hospital and medical treatment" was not covered in *Tuoi tre* and *Thanh nien*, the two leading newspapers in Vietnam.

Table 6.6 The association between types of newspapers and AI prime topic

	Sci. newspaper n=93	Gen. newspaper n=361
Education	4.3	8.3
Business and finance	54.8	54.0
Hospital and medical treatment	6.5	1.4
Gaming and entertainment	7.5	6.1
AI in general or others	26.9	30.2
$\chi^2=9.94, p<.05$		

Economic influence over AI coverage was not only limited to articles' topic and theme but also in terms of news frames. Our examination showed that "Economic prospect" which implies the economic aspect of science and its applications/implications, including business opportunities and financial possibilities and/or consequences, was the salient attribute the media agenda employ to frame public setting, shaping audience understanding of AI as major force for economic development (39.9%). There was a degree of consensus that the competence of AI-driven applications to economic ranged from expanding the manufacturing productivity³⁰, boosting the retail industry revenue³¹ to improving customer's buying experience³² and enhance the national competitive capacity³³. For example, AI was depicted to as a "leading solution for the economy reconstruction" (*Dau tu online*, 25 July 2018) and "a unique opportunity for Vietnam economy to speed up" (*Bao dau tu*, 24 August 2018). Generally, AI was constructed as an engine of productivity and economic growth, an all-purpose solution to create massive changes for the global economy and society but often with lacked concern on AI's potential effects.

³⁰ <http://vneconomy.vn/nhung-nha-may-khong-den-2018021302172432.htm>

³¹ <https://vietnambiz.vn/nhung-xu-huong-ap-dung-tri-tue-nhan-tao-trong-nganh-ban-le-114698.htm>

³² <http://cafe.vn/khong-chi-dao-thai-cac-shop-lua-dao-big-data-giup-nang-cao-trai-nghiem-khach-hang-tai-sen-do-20180120124832604.cfm>

³³ <https://baodaotvu.vn/tri-tue-nhan-tao-la-co-hoi-de-viet-nam-but-toc-d86781.html>

Table 6.7 Frame of AI articles

Frame	Number of articles (N=454)	Percentage (%)
Scientific progress	38	8.4
Economic prospect	181	39.9
Policy	67	14.8
Disaster	34	7.5
Public accountability	38	8.4
Localisation	25	5.5
Others or Unclear	71	15.6

The salience of economic was further consolidated with the predomination of industrial sources across news outlets. As seen in **Table 6.8**, “industry and business” were mostly cited as the first source and second source in Vietnamese news articles. Businessman and company were quoted in 32.3% of 331 articles having at least one source of information whereas they were directly or indirectly cited in 44.6% of 184 articles having at least two sources. The vast majority of these industrial sources were the company executive managers. It was very often that CEOs of international companies, such as Tesla CEO Elon Musk, and Mark Zuckerberg, CEO of Facebook, CEO of Google and Samsung Electronics or high level executives of local corporations, such as Chairman of Vietnam Posts and Telecommunications Group, Chairman of FPT Software, General Manager of BKAV Smart Home, were first sources cited in Vietnamese online news about AI. Notably, the news outlets managed by private media corporations tended to employ more industrial sources than those representing national media. *Viettimes*, a private news organisation that is on paper under the Vietnam Digital Communications Association, and *VnExpress*, a news site owned by a leading internet company in Vietnam, are the two where industry sources are the most cited. On the other hand, political officials and state institutions were the most widespread sources used by *Bnews* and *Bao tin tuc* – the two online publications managed by Vietnamese News Agency, and *The Voice of Vietnam (VOV)* – the online newspaper of the country’s national radio broadcaster. Particularly, *Dan tri*, which is directed by Ministry of Labour, War Invalid and Social Affair, was the only newspaper having an equal number of academic and industrial quotations, which are both higher than other news outlets. It also had more voices from NGO sectors and lay groups than the remaining reviewed newspapers. *Thanh*

nien and *Tuoi tre* were the two leading news organisations that used foreign and domestic newswires as their frequent sources. They were the exceptional outlets in which reference to news agencies was higher than business source (62.5% vs 0% and 20% vs 15%, respectively).

Table 6.8 The types of sources cited in AI articles

Source	First source^a (N=331)	Second source^b (N=184)
Expert and research institutions	19.0	16.8
Lay community	5.1	3.8
Politician and governmental organisation	31.7	29.4
Industry and business	32.3	44.6
New wire	8.2	2.2
NGOs	0.9	2.2
Others	2.7	1.1

a. The first agent/agency was cited in the story
b. The second agent/agency was cited in the story

Although the number of articles citing businessman and enterprise was not significantly higher than those having governmental statement (32.3% to 31.7% as first source and 44.6% to 29.4% as second source), the media preference to business source found in this study implied the more insufficient response of private sector to AI than the government. Additionally, the inferiority of academic to economic sources also revealed the shortage of Vietnamese local expertise who have competent knowledge to give comments on global science controversies, making it difficult and sometimes impractical for science reporters to find good sources and/or dig into the complicated scientific issues.

The domination of economic prospect in AI reporting is supplemented by data from our interviews. One particular reason is the lack of specialist science journalists who have adequate knowledge and skills to deal with controversies over AI. While S&T is placed at low position in most of Vietnamese newsrooms, “those who are appointed to cover AI are not science reporters. More often, they are economic or general reporters who tended to frame AI as a breakthrough that brings exceptional economic advances rather than a S&T issue that has both positive and negative impacts on society”, B2 explained for the media preference to AI application in industry and trading.

The second, but fundamental, reason for the salience of economic prospect in Vietnamese news is because the country's leaders have placed AI at heart of the economic development. A majority of our participants perceived AI as an innovation that can bring huge benefits to Vietnam, promoting economic growth and fostering Vietnam's position as an economic leader in the region. Participant C3 said that many of her colleagues acknowledge AI as a scientific progress and "only a very small number of journalists concern on AI long-term consequences". Due to this perception, AI is primarily framed as an economic possibility, an all-in solution for the industrial revolution 4.0. In the next section, the chapter will present how and why political influence on media coverage of AI.

6.6. Politicised media coverage of AI

As found in previous parts, along with the tendency to address AI as issues of economics, Vietnamese online news also emphasised their concern to how the government develops policies and law for promoting and regulating AI. Apart from "Trading and industry" which dominated the themes of reviewed articles with 42.3%, news about AI were also themed by "Policy and legislation", contributing 12.3% of articles in the analysis (**Table 6.5**). As an ongoing public concern, AI was further politicised through the frame "Policy" that Vietnamese news outlets concentrate in their coverage. 14.8% of samples, which contributed the second highest proportion of the reviewed articles, primarily analyse political and legal aspects of AI and its applications (**Table 6.7**). While AI regulation has not been authorised in Vietnam, the local media tended to discuss how China, Europe and the US support and govern AI, including their national strategy for AI promotion, the ethical and legal regulations as well as the roles of state and governmental bodies in AI governance. For example, *VTV Online* published an article in August 2018 providing an overview of strategy that the People's Republic of China design for their AI promotion ³⁴. The author introduced three stages of the project "A Next Generation Artificial Intelligence Development Plan" to make China overtake the US and European countries in the race of AI. Besides, the article also analysed the efforts and solutions of Beijing public authorities and private sectors to fulfil their national AI development goals. When discussing the national circumstance, the Vietnamese newspapers often

³⁴ <https://vietnamnet.vn/vn/thong-tin-truyen-thong/4-0-la-cuoc-cach-mang-ve-chinh-sach-nhieu-hon-ve-cong-nghe-485102.html>

informed the readers about the central government's attempts to renovate and update the national policy and regulations in the face of the rapid pace of technology change. For instance, there was a series of articles published on October 2018, highlighting the statement of Vietnamese Minister of Information and Communication that "4.0 industrial revolution is the reformation of policy rather than technology". On this account, the online news series about AI warned that Vietnam economy would be lagged behind other countries without strong, effective and immediate reformation actions³⁵.

The influence of politics over AI was not limited in themes and frames of stories. Following businessman and company, science journalists tended to approach a story by adopting state sources for AI issues. Politician and governmental department were often found as first and second sources in news articles about AI. 31.7% of the stories adopted state officials' statement as their first source whereas these governmental agents were cited as second source in 29.4% of the sampled articles. Indeed, research show news media often rely on government elites for their information (Anderson 2017). According to Hall et al. (1987, as cited in Anderson 1987), due to the virtue of their status in society, official sources are seen as "primary definers" that have privileged access to the media and, thus successfully set the news agenda and the subsequent debate. However, the state influence varies upon the nature of relationship between governments and news organisations. As Vietnam media are merely state-controlled, state information, such as press release, official proceedings, speeches and the like, is widely considered credible, reliable, legitimate and authoritative, particularly in matters of scientific and environmental uncertainty. Moreover, the media attach importance to AI policy probably stemmed from the Vietnamese strategic priority for AI. Furthermore, AI was often presented in "Policy" frame because it was inherently a powerful technology which demands for global governance framework. Regulating AI benefits and managing it risks is considered necessary for every country to make AI an essential force for economic and social evolution. The media, hence, play an essential role to inform and convey public understanding of AI issues and the governmental legislation and policy over AI consequences. In our analysis, Vietnamese news

³⁵ <https://hhandan.com.vn/thong-tin-so/nhung-bien-phap-thuc-day-cach-mang-cong-nghiep-4-0-339181/>; <http://tapchitaichinh.vn/nghien-cuu-trao-doi/viet-nam-san-sang-don-nhan-cach-mang-cong-nghiep-40-143735.htm>;
<http://vneconomy.vn/kinh-te-so-khong-de-chinh-sach-duoi-doanh-nghiep-ra-khoi-viet-nam-20180907130250357.htm>

media was found to have a substantial effort to raise concern to AI subsequent policy. However, the coverage mostly focused on the state legislative strategy to encourage AI research and industry. There were limited stories scrutinising the regulatory frameworks and legal boundaries to manage AI practices and its associated risks, especially the transparency and ethical implications that AI might about AI policies and initiatives were also missing in media presentation of AI.

6.7. The heavy focus on AI benefits

While media presented AI as the leading force for the massive development of Vietnamese economy and the news framing of AI policy primarily focused on legislative protocols to foster AI research and business, it is reasonable to find the media heavy emphasis on progress and potential economic benefits gained from AI, and with little discussion on its attendant risks. As shown in the data, AI was recognised as an all-in solution to on-going problems, from healthcare to government management, productivity capacity to national security and so on. **Table 6.9** shows that a majority of reviewed AI articles (N = 325, 71.5%) covered benefits whereas those focusing on “*only benefit*” accounted for more than half of the total samples (N = 229, 50.4%). On the other hand, although discussion of AI risks, such as automation and job loss, was a tenacious concern across coverage with 42.9% of articles mentioning AI harms and threats, a smaller number of news stories emphasising on “*only risk*” (N = 30, 6.6%). Likewise, the frame “*Disaster*”, which including the two sub-frames “*Pandora’s box*” and “*Run-away*”, describing the existing irreversible consequences or potentially serious threats that AI might drop on humanity, took a minority part in the total samples (N = 34, 7.5% - Table 6.7).

Table 6.9 Risk and benefit presence in AI articles

	Frequency (N=454)	Percentage (%)
Benefit only	229	50.4
Both risk and benefit	96	21.1
Neither risk nor benefit	99	21.8
Only risk	30	6.6

In order to identifying the relationship between risk and benefit and the primary articles’ theme, a chi-square test of independence was run and found a significant

difference between the presence of risk/ benefit and story themes ($\chi^2(15, 454)=86.57, p< .001$). **Table 6.10** shows a cross-tabulation of risk and benefit coverage and theme variables. Results show that:

Table 6.10 The association between theme and the presence of risk and benefit

	Risk and benefit presence			
	Both risk and benefit	Only risk	Neither risk nor benefit	Only benefit
Scientific process and achievement	8.3	10.0	2.0	15.3
Applications and implications	15.6	13.3	2.0	4.4
Policy and legislation	12.5	10.0	23.2	10.0
Trading and industry	38.5	20.0	30.3	52.0
Public perception	12.5	20.0	7.1	8.7
Other or unclear	12.5	26.7	35.5	9.6
$\chi^2=86.57, p<.001$				

- Stories about “scientific process and new achievement” were more likely discussed in terms of “only benefit” (15%) than “only risk” (10%).
- Stories about “applications and implications” were more likely discussed in terms of “both risk and benefit” (15.6%) and “only risk” (13.3%) discourse than “only benefit” (4.4%) and “neither risk nor benefit” (2%).
- Stories about “policy and legislation” were less likely discussed in terms “only risk” (10%) or “only benefit” (10%) than “neither risk nor benefit” (23.2%).
- Stories about “trading and industry” were more likely covered through discussion of “only benefit” (52%) and “both risk and benefit” (38.5%) than “neither risk nor benefit” (30.3%) and “only risk” (20.3%).
- Stories about “public perception of AI”, including debate over AI prospect and threat, were more likely discussed in terms both sides of “only risk” (20%) and “risk and benefit” (12.5%) than “only benefit” (8.7%) and “neither risk nor benefit” (7.1%).

Generally, Vietnamese newspapers tended to frame AI innovation and development more beneficially while their coverage of AI ongoing applications and implications was involved in both promise and peril. Among six analysed themes, the news discussions over AI applications and implications and public engagement in AI

controversies were more often associated with risk frame. However, the frequency of risk presence was much less than benefit.

In terms of what specific risk and benefit journalists concerned and presented, as might be expected, data show that “economic issues” were predominant. As seen in **Table 6.11**, local science journalists often focused on the possibility that AI-based technologies would enable poverty reduction, improve manufacturing productivity and enhance Vietnamese competitive capacity (53.5%). At the same time, they paid considerable attention to the long-term and inevitable impacts of AI chain on both macro and micro economies (33.6%), such as AI might cause job losses and widen the gaps between developed and underdeveloped countries, front-runners, followers and laggards companies, high skilled and low skilled workers. Along with economic concern, local journalists tended to present multiple benefits and risks in an article. Of 189 stories mentioning risk, 33.6% was highly associated with multi-risks whereas of 325 stories mentioning benefit, 28.6% detailed multi-benefits.

Despite this similarity, journalists varied their focus on other types of risk and benefit. Particularly, in terms of risk, despite the assumption of a severe media concern on AI ethical risk, the news focusing on the ethical aspects of AI was presented in only seven articles, contributing 5.6% of the articles that covering risk. Instead, there were more concerns on social consequences, such as the how AI-led weapon would threaten human security, how robot would replace human jobs, how AI algorithms would give bias information against certain groups or in favour of others.

Table 6.11 Type of AI risks and benefits

	Frequency	Percentage
Type of risks (N=189)		
Economic issues	42	33.6
Social issues	25	20.0
Ethical issues	7	5.6
Multi-risks	42	33.6
Other or Unclear	9	7.2
Type of benefits (N=325)		
Laboratory	2	0.6
Economic issues	174	53.5
Social issues	20	6.2
Ethical issues	1	0.3
Health and medical issues	10	3.1
Multi-benefits	87	26.8
Other or Unclear	31	9.5

In terms of specificity and intensity of risk and benefit, overall observation found both of the specificity and intensity were moderate. Yet, the intensity and specificity of benefit (M = 3.68, M = 3.58) were slightly higher than intensity and specificity of risk (M = 3.55, M = 3.42). In order to identify the association between theme and the risk - benefit intensity and specificity, a set of independent samples ANOVA test was performed. **Table 6.12** shows themes did not have significant effect on presented risk and benefit intensity as well as risk specificity. However, we found a significant effect of themes on benefit specificity ($p < .05$).

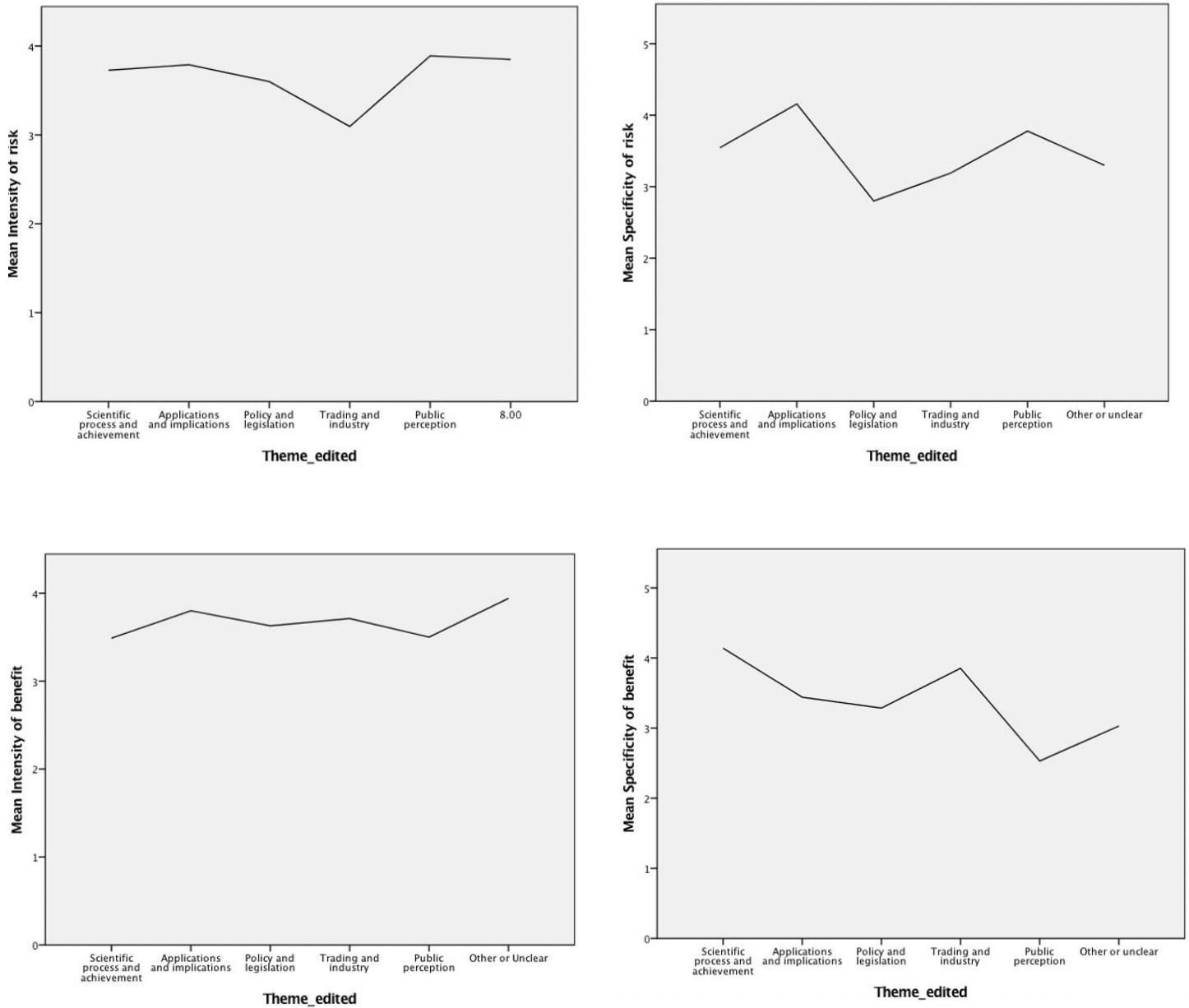
Table 6.12 The intensity and specificity of AI risk and benefit

	Mean						
	Mean	Scientific process and achievement	Applications and implications	Policy and legislation	Trading and industry	Public perception	Others or unclear
Risk intensity ^a	3.55	3.73	3.79	3.60	3.10	3.89	3.85
Risk specificity ^a	3.42	3.55	4.16	2.80	3.19	3.78	3.30
Benefit intensity ^a	3.68	3.49	3.80	3.63	3.71	3.50	3.94
Benefit specificity ^b	3.58	4.14	3.44	3.29	3.85	2.53	3.03

Specificity: 5likert scale from 1 "not at all specific" to 5 "very specific"
Intensity: 5likert scale from 1 "very low" to 5 "very high"
a. $p > .05$
b. $p < .01$

For the ease of navigation, **Figure 6.2** visualises the data in **Table 6.12** on the theme influence on the extent of benefit specificity. A further post hoc Tukey's honestly significant difference test indicated that the specificity of benefit was significantly different between "Scientific process and achievement" (M=4.14) and "Trading and industry" (M=3.85) with "Public perception" (M=2.53) (data not shown).

Figure 6.3 Graphical representation of mean differences in AI risk and benefit intensity and specificity across themes



As a result of the benefit preference, the study found an overall positive attitude of media towards AI throughout the entire period. The tone of both headlines and leads were more likely to be positive than negative (data not shown). In terms of the explicit stance of journalist towards AI, an overwhelming majority of AI news emphasises its positive possibilities (84.7%), while opposing stories accounts for only 2.6% of the sample and a balanced and neutral viewpoint towards AI is present 12.7%.

Table 6.13 The explicit stance towards AI

Evaluation	Frequency (N=417)	Percentage (%)
Opposed	11	2.6
Neutral	53	12.7
Favoured	353	84.7

A further crosstabulation found a significant difference between theme and the general journalists' perspective on AI issue presented in the stories ($X^2(10, N=417)=74.34, p<.001$). **Table 6.14** shows journalists tended to support AI commercialism and the state initial policies towards AI. Notably, opposite viewpoints are absent in the themes: "*trading and industry*", "*policy and legislation*", and "*applications and implications*". The media opposing to AI was presented in stories about emerging AI discovery and public engagement in AI practice. Crosstab data also found discussion over "*policy and legislation*" tended to give an impartial attitude towards AI. However, compared to the predominance of articles which were in favour of AI, articles associated with neutral and balance assessment, along with those was likely against the AI, was still a small part of the overall mix.

Table 6.14 The association between theme and the explicit stance towards AI

	Theme					
	Scientific process and achievement	Applications and implications	Policy and legislation	Trading and industry	Public perception	Other or unclear
Opposing	11.1	0.0	0.0	0.0	14.0	0.0
Neutral	11.1	39.3	6.9	7.5	11.6	24.6
Favoured	77.8	60.7	93.1	92.5	74.4	75.4
$X^2=74.34, p<.001$						

In exploring the causes of this overexcitement, our interviews show that there are both internal and external reasons for the media favour to AI. From the journalist's stance, according to B2, "we science journalists do not have enough time to follow on each S&T issue. It is challenging for us to have comprehensive understanding of AI". Thus, a large number of participants are more likely to pick up AI breakthrough events for their news coverage. They seldom provide a thorough analysis on AI

limitations or its long-term consequence on human race. Participant C4 criticised “Of course journalists are often excited in new achievements. But their excitement is so significant that they tended to frame AI as an all-in solution for Vietnamese agricultural economy”.

Apart from that, the media’s general favour to AI stems from the Vietnamese scientists’ enthusiasm about AI benefit. According to C3, “in a recent AI conference organised by my newspaper, a majority of both foreign and local scientists primarily is on the side of AI benefits. Only a small number of scholars is sceptic about AI threats”. These indicators, along with the lack of expertise to uncover S&T limitations, lead to media overall support to AI, even though not all AI applications are equivalent to Vietnamese local circumstance.

6.8. Insufficient connection between global issues and local contexts, despite the prevalence of local stories

As the literature shows a heavily dependence of science journalism in developing countries on international sources, especially the news media in developed countries, it was expected that the Vietnamese media coverage of AI would follow the same pattern. Yet, **Table 6.15** reveals that news articles on international events/issues account for only 40% reviewed articles (N=163), 20 percentage points less than stories presenting the local ones (N=258). According to Badenschier and Wormer (2012) there are a plenty of factors that have high impacts on science news selection, including: astonishment, composition, controversy, economic relevance, graphical material, intention, personalisation, political relevance, range (number of affected people), reference to elite persons, relevance to recipients/society, scientific relevance, actuality, unexpectedness. Of these elements, it seems that the relevance to senior politicians, the importance of event to science progress and recipients/society gave rise to the Vietnamese media substantial attention to domestic stories. As foreseen in section 6.4, during the examined period, the peaks of AI coverage were often in correspondence to latest statements of local elites or regulatory bodies and several momentous AI events, such as the first robot granted human citizenship, Sophia, took part in the Industry 4.0 Summit and Exhibition held in Hanoi on July 2018. The media preference of domestic to foreign AI events/

issues which contrasts with their favour to international GMO stories implies their distinct approaches to particular science controversy.

Table 6.15 The localisation of AI news in Vietnam

		Frequency	Percentage (%)
Geographical scope of event/issue (Based on entire samples, N=454)	Foreign	163	35.9
	Domestic	258	56.8
	General	33	7.3
Link to local context (Based on the number of stories with an international scope, N= 163)	Yes	58	35.6
	No	105	64.4
Source of original material (Based on the number of stories with an international scope, N= 163)	Mainly original reporting	5	3.1
	Mainly translated reporting	158	96.9
Source of translation (Based on the number of translated stories, N=70)	Original scientific sources	4	5.5
	News outlets or websites	64	87.6
	Not mentioned	5	6.8

In addition to the larger interest in domestic research and development of AI, news coverage of AI also cited more indigenous sources than foreign sources. The proportion of citations by local agents and/or agencies was slightly higher than international actors. As seen in **Table 6.16**, more than half of the first source and second source were Vietnamese (50.9% and 57.9% respectively). In contrast to what has been found in previous chapter, which shows GMO news that was dominated by foreign sources, media coverage of AI gave more preference to local sources. The substantial contribution of local sources suggests that AI was an emergent issue that could attract considerable attention of local experts, politicians and lay persons.

Table 6.16 Origin of the cited source

		Frequency	Percentage (%)
First source^a	International	163	49.1 ^a
	US	89	54.6 ^c
	China	21	12.9 ^c
	Others	53	32.5 ^c
	Vietnam	169	50.9 ^a
Second source^b	International	77	42.1 ^d
	US	43	55.8 ^d

<i>China</i>	10	13.0 ^d
<i>Others</i>	24	31.2 ^d
Vietnam	106	57.9 ^d
<i>a. Based on number of articles having one source, N=332</i>		
<i>b. Based on number of articles having at least two source, N=183</i>		
<i>c. Based on number of articles having international source, N=163</i>		
<i>d. Based on number of articles having international source, N=77</i>		

Despite the emergence of local news about AI, foreign originated news played an important part in informing public about AI knowledge. The repackaging of science news from international wire services was especially common in topics related to “Business and Finance”. However, of 163 stories which had international originality, only one third (N=58, 35.6%) provided links to domestic circumstances. The remaining articles (N=105, 64.4%) offered little or no relevant linkage to local context, local policy and local people. Moreover, only a minority number of foreign news was originally reported by Vietnamese correspondents or the newsroom’s international reporters and contributors (N=5, 3.1%). The majority of international stories were merely translated from foreign sources including original scientific sources, such as academic journals, research announcements, and newswire stories from sources such as *BBC*, *The Guardian* and *Daily Mail* (N=158, 96.9%). However, due to their lack of ability to access, understand and explain original science data from scientific press release, academic article, scientific report, only 5.5% of the translated stories chose original academic sources for information. Most of the time, journalists tended to duplicate science pieces from foreign newspapers and websites (87.6%). It was very often to find the hollow “gee-whiz” coverage of AI new discoveries in Vietnamese news, such as a portrait picture painted by AI program being sold for \$432,000 or the first AI news presenter introduced in China, an AI robot running for Mayor of Tokyo. In-depth articles describing the international AI issue/ event with enough concern and relevant evidence into local reality were almost absent in the news. For example, Vietnamese newspapers paid a substantial attention to the presentation Stephen Hawking delivered in the Lisbon Web Summit 2017 as well as his well-known warnings about the AI worst hazards. However, the indigenous media primarily replicated what international newspapers reporting Hawking’s conjectures about the rise of powerful, conscious machines. The local newspapers almost neglected to link his forecast to internal context.

On the opposite side, there was a lack of news about domestic AI events and issues with links to international developments. In the momentous Industry 4.0 Summit and Exhibition 2018 held in Hanoi on July 13, the Vietnamese media was seething with the visit of the first humanoid robot Sophia. Instead of taking this opportunity to describe and analyse the event in connection to larger structural issues, local journalists tended to soften the news about her participation, such as how Sophia looks like in Vietnamese traditional dress Ao dai³⁶ or how she reacts to the journalists³⁷ and even Sophia might have a younger sister³⁸. Such sensational stories dominated news about the Industry 4.0 Summit and Exhibition, eclipsing the domestically hosted international event's principal messages. Furthermore, there was an absence of voices from local professionals, such as opinion leaders, legal personnel, and businesspeople on the big event. The media coverage of AI controversies, hence, was infrequently analysed in terms of their connectedness between global and local perspectives.

In order to explore the association between themes and event/ issue localisation, a chi-square test was run and found a statistically significant difference in locality of event/ issue across themes ($X^2(10, N=454)=75.03, p<.001$). **Table 6.17** reveals a majority of stories introducing scientific process and new achievement are sourced from foreign countries. The predominance of international to domestic event and issue would stem from the fact that AI research in Vietnam is still in infancy. Thus, local media tended to reflect AI breakthroughs from more scientifically advanced countries. In contrast to the dominance of international stories about "scientific process and achievement", news coverage of AI regulation and policy, AI commercialism and industry were more likely associated with events and issues happened inside Vietnam.

Table 6.17 The association between themes and locality of AI even/ issue

	Locality of event/ issue		
	Foreign	Domestic	General
Scientific process and achievement	22.7	2.3	15.2
Applications and implications	7.4	6.2	9.1
Policy and legislation	8.6	18.2	0.0

³⁶ <https://tuoitre.vn/can-carh-robot-sophia-mac-ao-dai-tro-chuyen-o-viet-nam-20180713120414025.htm>

³⁷ <https://viettimes.vn/robot-sophia-ngot-nao-va-man-tra-298292.html>

³⁸ <https://thanhnien.vn/cong-nghe/robot-sophia-tung-den-viet-nam-sap-co-em-gai-1028543.html>

Trading and industry	29.4	50.8	39.4
Public perception	10.4	10.1	6.1
Other or unclear	21.5	12.4	30.3
$\chi^2=75.03, p<.001$			

Despite that, there is still the aforementioned lack of localisation in a large number of international AI events and issues. As a result, according to C3, “news media do inform public about AI, but the information is not contextualised into the local circumstance. Without any linkage between international and local contexts, media coverage of AI doesn’t have direct impact on policy over AI research and its application”.

One reason leading to the insufficient connection between foreign news about AI and local condition is caused by the shortage of Vietnamese scientists who have proper knowledge to give advices and comments on international issues. This issue, which was discussed in previous chapter, another time, is highlighted by C5 “There is difficult to find a local AI scholar who is expertise and willing to answer”.

6.9. Further analysis and primary conclusions

This chapter aimed to provide some insights into how the ongoing controversial AI is covered in the Vietnamese news media. It sought to examine the tendency, prevalent themes and frames dominated the AI coverage and identify the media viewpoint towards AI risks and benefits by quantifying and analysing newspaper content related to the AI event and issues.

While scholarly attention to media coverage of artificial intelligence is at its early stage, the fledging international literature consistently reveals an increase in the volume of AI news in recent years. Although our review is not a longitudinal study, evidence from Vietnam consolidates the general upward trend in the news coverage of AI. AI has attracted substantial Vietnamese news attention despite the low media interest in science and technology as well as the backseat of science in most of Vietnam’s newsrooms. However, the study found that media concern on AI is only at basic factual level. News about AI is primarily driven by significant events or when the crucial role of AI is voiced up by the key political leaders. Similarly to previous research on how a science story becomes an media story (Neresini 2000), and how

news about climate change attracts media attention (Romps and Retzinger 2019), this examination discovered notable AI events that bring both hopes and fears can make itself valuable for the mass media and increase AI's newsworthiness. For example, the participation of the world first robot citizen in the Hanoi Industry 4.0 Submit and Exhibition, which brought both curiosity and hesitancy to audience, led Vietnamese news on AI reaching the peak during the event.

Previous studies on UK media representation of AI found a predomination of industrial topics in AI coverage (Brennen et al. 2018). A plenty of recent studies in the US (Chuan et al. 2019) as well as cross-sectional studies of news coverage in the US and UK also reveals an industrial-led AI portrait in the news (Zhai et al. 2020). Our data support these findings with the media preference to AI topic "AI business and finance" and theme "AI trading and industry". AI was also dominantly framed as an "economic prospect", a potential solution for economic development. Due to the priority placed on AI economic values, businesspeople and corporations were the most sourced across the sampled articles (even more than politician and governmental employees). The preference of AI as a private commercial concern to political or public issues is against the general tight political grips on science reporting in developing countries (Nguyen and Tran 2019). As already seen, in authoritarian systems such as China and Vietnam the state usually controls over science news output and media often rely on politician and public officials for science information. Di and Fang (2019), for instance, found the Chinese state's overarching influence on media coverage of AI. This study, however, reveals an industry-led AI representation in Vietnamese news media, implying the unusual inferiority of the government to private sectors in response its the rapid growth. However, as an emerging science and technology innovation that Vietnam government prioritise to its development, AI news is also politicised through the themes and frames that media organisations concentrate in their coverage. Online newspapers tended to highlight issues of AI policy and legislation as well as governmental effort and strategy to promote AI research and practice. While the political influence on media coverage of AI was also found in Western countries (Brennen et al. 2019), our study reveals a different way by which AI was politicised in Vietnam news media. Different from the West, particularly the UK's politically divided news landscape in which left and right-wing outlets have distinct political approaches to AI, Vietnamese media

almost consistently framed AI as a leading force for national development. While this approach might prevent the overaction, caused by political contradiction, towards AI discussion, the prevalent framing of AI's positive prospects can also oversimplify public understanding of AI.

Indeed, the findings reveal that rather than an emergent technology consisting of both promise and threat, Vietnamese journalists primarily drove public discourse about AI novelty. It stands in contrast to the common critics about the newspapers' amplification of AI potential threats (Select Committee on AI 2018, as cited in Brennet et al. 2019, Schwartz 2018). Although we, like Brennen et al. (2018), found some stories sensationalising AI hazards, the prevalence was far less than it was expected. Especially, opposed to the expectation of media concern on issue around AI ethics, the review finds an almost absence of discussion over AI moral dilemmas. Only two sampled articles were framed by "ethical concern", weighing up the pros and cons, and making value judgments towards the AI risks and benefits. The Vietnamese media advocacy of AI benefits supports Kirkpatrick (2019), Di and Fang (2019), Chuan et al. (2019) and Zhai et al. (2020) that in the early stages of AI debate, the mass media seem not overly concerned with its threats and limitations. In fact, similar to media coverage of nanotechnology (Anderson et al. 2005, Cacciatore et al. 2012), newspapers emphasised positive themes of AI novelty and benefits over negative themes of danger and risk. This study further supports these observations by providing evidence of the media's heavy focus on benefit frames. Particularly, several specific themes were more likely discussed with benefits than others.

For example, "AI research process and new achievements", "AI trading and industry" "Public perception of AI" were more frequently accompanied by beneficial discourse. The press support to AI was also found in the overwhelming favour attitude to the uptake of AI, especially in business and production. This positive coverage is equivalent to media representation of other emerging science innovations in developing countries. As showed in Nguyen and Tran (2019) and analysed in Chapter 2, news reporting in developing countries have tendency to excessively celebrate the benefits of new science discoveries or emerging technologies. Reis (2008) found that Brazilian media tend to be overexcited, heavily focusing on its

medical advancements with celebratory language” while ignoring the fact there is no sufficient evidence for their effectiveness. This overexcitement of Vietnamese journalism about AI stems partly from the influence of AI industry’s effort and government strategy to shape public perception of AI’s leading role for the national industry 4.0. Furthermore, it is resulted from the journalists’ lack of professional knowledge and specialist reporting skills to critically examine and cover the complicated and uncertain science issues. Instead of informing public about the AI advancements and their implications, they often provide stories on the basic available research findings, duplicate AI foreign news or recap event agenda. As lay publics are not well-informed, they find it challenging to have a comprehensive understanding and adequate preparation to promote AI advantages and address the potentially irreversible damages associated with certain uses of AI technology.

Of particular interest and importance is the finding that there was a media preference of local to international AI events/issues. Compared to the heavy domination of international to local science news in most of the developing countries, this is rather unusual. Such preference is probably caused by the Vietnamese government’s significant encouragement to embrace this emergent technology. On the other hand, it might result from the public increasing interest on AI. The precedence of indigenous AI stories in Vietnamese press implies that AI is not only a science fact but also a national issue involved in and impact on every aspect of people lives.

While the media offer a substantial space for local stories, there was a shortage of international news with adequate linking to national context. Of the world news found in our analysis, a majority is repacked from foreign sources without contextualisation and rare comments from domestic scientists. It was very common to find a hollow “gee-whiz” coverage of international AI achievements. The scant number of localised stories reflects the journalists’ lack basic science knowledge and expertise skills as well as support from their newsroom leaders and indigenous scientific community to deal with the sophisticated AI debate outside the national borders.

Placing the study’s findings in the literature on science journalism in developing countries, our preliminary findings show a glimmer of a hope in the media increasing their attention to science controversies, but it is hard to see a definite trend. The domination of event-driven and superficial reporting, along with overexcitement to AI

benefits, shows that Vietnamese science journalism is still far from the necessary level of professionalism. Given that most of public knowledge is likely obtained from science news, they deserve more in-depth and critical media coverage. The apparent shallow reporting may lead the public to overoptimism towards benefits and less concern on the risks associated with AI. With the failure to build public knowledge of AI, science journalism in Vietnam is far from fulfilling the role that it should hold for development causes in the Global South. In the future, if AI fails to reach a more critical treatment within the media coverage, the diverse perspectives around AI are likely to become homogeneous, possibly weakening or even eliminating the engagement of different social actors in the much-needed debate about AI's economic, social and political implications. Furthermore, if the controversies over AI disappeared, the issue would lose its place in the news and thus would make it even more challenging for science journalism in Vietnam to make AI a public concern, to empower lay communities and to strengthen their engagement in the AI debate.

Findings presented in this study provide some crucial insights for future research into media coverage of emerging science controversies in Vietnam and other developing countries. Yet, there are some limitations to take into account. First, the research is limited to stories published in 2017 and 2018. The small number of samples could not represent the longitudinal trend of AI coverage across the recent years. Second, the frames were adopted from Bauer et al. (1995), Durant et al. (1998), Nisbet and Lenwenstein (2002) might not be sufficient to study media coverage of science controversies in the Globe South. Third, as a content analysis, this study cannot and does not aim to explore the potential impact of journalists' attitudes to AI and the associated framing devices. Further studies should take these limitations in account to delve more deeply into the factors influencing the news overexcitement about AI, discovering whether the media's favour of AI benefits distorts public perception of AI's risks and limitations, whether this positive reporting reflects the actual social and public attitudes towards AI in general, and whether this benefit hype is a result of science competition to secure a news story space for inclusion or it stems from the newsroom's over-reliance on PR press release (Williams and Clifford 2009, Allan 2011, Murcott and Williams 2012). More examination with science reporters and other involved actors might be required to provide a better understanding of how and

why science media in developing countries like Vietnam fail to accomplish its critical role that it should hold for their development causes.

Chapter 7

TOWARDS A BETTER FUTURE OF SCIENCE JOURNALISM FOR DEVELOPMENT: VIETNAM AND BEYOND

With the exception of some countries, such as Germany (Elmar et al. 2008), science journalism across the globe has continued to see a general shortage of resources and output in the first decades of the 2000s. The decline of traditional journalism business model, along with the rise of Internet and multi-media platform, the increasing commercialism of scientific research, especially in the Western media, have a considerable impact on science journalism around the world (Brumfiel 2009,

Williams and Clifford 2009, Bauer et al. 2013, Ashwell 2016). While relevant data are sparse, there are signs that developing countries, where science journalism has rarely been a strong part of newsrooms, might be facing tougher challenges in the years ahead. For example, Latin American science journalists suffered an increasing pressure of closing-down science beats whereas dedicated science teams and sections remains a “luxury” in Asia and Africa (Ekanem 2003, Schanne et al. 2009, Dutt and Garg 2012, Michael and Binta 2013). Even in China and India, where S&T is highly appreciated as the major force for the national development and has achieved great success in S&T sectors, science journalism has not been a widely recognised concept (Navarro and Hautea 2011, Dickson 2012, Ramalho et al. 2012, Zhao et al. 2014, Carlétti and Massarani 2015).

Placing Vietnam in that broader context, this study set out to answer three key questions: (a) **“How do Vietnamese science journalists perceive their professional roles in Vietnam’s development processes?” (RQ1)**; (b) **“What are the key challenges to professional science journalism in Vietnam?” (RQ2)**; and (c) **“How are global scientific controversies represented in Vietnamese news media?” (RQ3)**. From in-depth interviews and content analysis, this study has found a wide range of issues and challenges that are similar to what have been seen elsewhere. The findings about science journalism in Vietnam in this research provide some important perspectives and insights that can serve as reference points for future examinations of issues around the Global South’s science journalism and its consequences on their development causes and processes. This chapter summarises and discusses these findings and implications as well as some possible ways for science journalism to contribute more substantially to development in Vietnam and beyond.

7.1. Summary of findings and implications

The general decline of science journalism in other countries was not detected in the case of Vietnam, it was probably not because there was no decline but because the very low base of its science journalism made it hard to see how it could have gone lower. As seen in chapter 2, science journalists in Vietnam have a high normative expectation of their central role and critical mission to promote science communication and foster national development. However, they have experienced a

hard time placing science journalism to the heart of development. Instead of offering the public appropriate and in-depth science knowledge, alerting them to their long-term consequences on development, science journalism in Vietnam has not done a good job in bringing science to the core of that process. Science reporters heavily rely on foreign sources for S&T information whereas a rarity of indigenous S&T events and issues are presented by the media. When it comes to domestic science, there is a lack of in-depth reporting that could provide an informed, critical and vigilant analysis of scientific advancements and caveats. Vietnamese science journalism tends to take the superficial form of short and straight news about concrete one-off events rather than thematic and/or detailed analysis of issues.

Findings from the content analysis in chapters 5 and 6 – media representation of global scientific controversies, GMO and AI – confirm the interviewed data. There are several differences in news coverage of GMO – a prolonged debate – and AI – an emerging controversy – e.g. the media give more attention to controversies over AI than GMO, GMO news excessively relies on foreign sources while media coverage of AI sources more local information. But generally, Vietnamese newspapers tend to excessively celebrate benefits of new science discoveries or emerging technology. Instead acting as a public watchdog, informing and alerting public with science potential consequences, the press primarily acts as a guard dog for the interest of powerful vested groups, i.e. the state and commercial agent/agencies. Civic groups, which are expected to play a substantial position in scientific debate are absent in the news. There is a dominance of governmental and business sources. In addition to the lack of critical science reporting, international stories are infrequently covered in connection to domestic legislative process and public decisions whereas “home-made” S&T events and issues were hardly analysed in relation to global developments. In sum, science journalism in Vietnam is far from accomplishing its normative missions for sustainable development.

The Vietnamese media’s failure to promote public understanding of science and ensure knowledge creation, acquisition and sharing resembles what has been seen in other parts of the developing world. As our systematic review (Nguyen and Tran 2019) and other studies (e.g. Bauer et al. 2013) have shown, such failure is due to both *internal problems* of the news industry, such as editors’ indifference and half-

hearted commitment to science news, the poor work condition and low payment, the lack of specialist training for science journalists and the rampancy of low ethical standard and *external forces*, e.g. commercial and political interests, the reluctance of scientists and their institutions. These problems are not unique to developing countries but can be found, to a lesser extent, in more advanced societies, where science journalism is not completely immunised from obstacles such as the lack of investment in science news, staff cuts, ineffective relationships between journalist and scientific community, the influence of PR practice on science reporting and so on. Such challenges, however, would bring more adverse impacts on growth and progress in the developing world because they work often in tandem with many other distinct challenges, i.e. poor living standards, weak governance, tight political grip on media, underdeveloped scientific activities, low public literacy, absence of science communication platforms and lack of intuitional effort and mechanism to disseminate science knowledge. For example, Hin and Subramaniam (2014) pointed out that low literacy in many developing countries probably decelerates the diffusion of science messages to the public in daily life. Additionally, uncritical thinking would aggravate the public lack of curiosity and understanding of science rationality as well as its bias and implication.

Further, the absence of a well-established science communication structure, in Vietnam and beyond, leaves science journalism as an almost exclusive player in keeping the public well-informed about S&T updates and their impacts on human life. As such, the same professional flaws of science journalism can have far worse consequences on a developing country like Vietnam than any in the North. The rarity of S&T in the news agenda can lead the lay public of the South, who obtain science knowledge almost solely from mainstream media, will have few more channels to engage with new S&T developments. In the absence of critical science reporting, for example, the media's negligence of the potential risks and overexcitement over benefits of emerging technologies – e.g. GM food, nanotechnology and artificial intelligence – can weaken the ability of the South, which is more often a science receiver than developer, in dealing with their long-term consequences. The lack of linking international science issues to local contexts can either put a dearer price to countries like Vietnam because not all technology in the scientifically advanced countries is applicable for domestic circumstance of the developing world. Further,

several countries in the South have been dumped with outdated technologies mainly from the North. While lay public in Vietnam primarily depend on journalism for S&T knowledge and advices, the absence of vigilant coverage would eliminate public and policy makers' awareness of, rational response to and active engagement with S&T into their daily socio-cultural, economic and political life. The ultimate consequence is that developing countries lags even further in already uneven globalisation processes.

Additionally, the generally lower level of media literacy and the less democratic nature of socio-political systems in the South mean that there will be few civil and institutional mechanisms that exist to bring journalism's professional issues to the public's consciousness and conscience as well as to help its practitioners to tackle them. For science journalism, that translates into not only the unfortunate pleasure of facing few external pressures to reform but also the existence of less support for reform initiatives. Philanthropic funders for science journalism that are common in the North (e.g. Knight Foundation, Wellcome Trust), for instance, are rare in the South, Vietnam included. As mentioned in Chapter 2, a professional association of science journalists, which would be able to promote science journalism, has not been established in Vietnam. Capacity building for the media has been done mainly at the support of international public or private donors, i.e. Scidev or, The Federation of Science Journalists, who themselves are not always free to support what they wish to support.

7.2. Looking to the future

However, this research suggests that journalism about science in Vietnam, and developing countries in general, could reform itself to reduce some of the problematic consequences that it has made on developing societies and thereby bring more opportunities for a brighter future of science journalism. Although some of the permanent constraints, such as state authoritarian, lie in macro socio-political structures and are not easy to eliminate in any short term, others – such as the excessive reliance on foreign sources, the lack of critical science reporting

(especially in relation to science risks and benefits), or the ineffective working partnership with local scientists and science-related organisations – are within the capacities of the media to change. A reform process can be initiated to build a brighter future for science journalism in Vietnam, as well as other countries of the Global South. The following principles could be inferred from this study:

- ***Science journalism must have a proper place in development strategies and initiatives.***

One main aim in this study is to address the lack of research evidence on what science journalism contributes to national development. It has been done so by analysing the practice of science journalism, with focus was given to both perception of reporters and their coverage of S&T issues. The findings show that there is a long way for Vietnamese science journalism to reach its mission for national development. The core impediment of this, as pointed out in Chapter 3, is because science journalism was not put in the role that it deserves for development. Vietnamese science reporters, editors and newsroom leaders, as well as other science news stakeholders, such as scientists and policy makers, as mentioned above, have not well recognised science journalism and its significant role in tackling developmental causes and challenges. Thus, the importance of science journalism for developments is in need for more appreciation by all stakeholders, especially news executives.

In the literature, it is clear that science journalism maintains its significance for public understanding of and engagement in science and technology, even in societies with strong science communication. Science and the Media Expert Group Report shows that a vast majority of British adults gain most of their science knowledge from the mass media (Fox and Collis 2010, p.3). Scientists in a survey by Allgaier et al. (2013), prefer traditional news platforms, such as newspaper, television and magazine for their science updates despite their belief that new mediated outlets, such as blogs and online social network do have influence on the public and policy makers. Another recent report of PEW research centre finds a majority of Americans relied on general news outlets for science information and speciality media sources, e.g. documentaries and science magazines, for science fact validation, despite the impact of social media on news assumption (Funk et al. 2017). News coverage of

biotechnology, nanotechnology, climate change, provides good examples of how the news media can place science issues on the public agenda and engage people in science processes at global and national levels. Particularly, the revival of science journalism during the ongoing novel Coronavirus manifests its indispensable role for ensuring public full access to qualified and timely science information. More than ever, the pandemic is a wake-up call that specialist science journalism matters (Niekerk and Villiers 2020). Without analytical science and health journalism, lay community find it hard to access science knowledge, validate its caveats as well as the underlying social, ethical and political consequences. In the shuffle of Covid-19 infodemic, once misinformation enters the social media echo chambers, ordinary people easily fall into the pitfall of misunderstanding or incomplete understanding of scientific claims. Covid-19 has reinforced the role of science journalism in the newsroom, emphasising it as decisive as political and economic reporting.

Indeed, this vital role of such journalism in gatekeeping and engaging developing populations with the fast-pacing global flow of S&T and their controversies is recognised by several participants in this study. Although not all interviewed journalists and editors have appropriate awareness about what and how science journalism should stand and do for national development, they had a high expectation to make journalism a key vehicle of information and advice for their people to properly deal with these impacts both at micro-individual and macro-societal levels. This function is not only vital but also almost exclusive to the media, because other key stakeholders in science communication in Vietnam – such as the scientific community, the civil society and the political elite – are unlikely to provide alternative avenues for meaningful science information and engagement. As discussed, scientists and science institutions do not have a strong flavour, incentive or expertise for public outreach and engagement initiatives. Meanwhile, the political elite of Vietnam tend to see science and development policy-making as a domain of their own rather than one within the public sphere. And, under a typical authoritarian hierarchy of the developing world, non-governmental organisations and civil-society groups do not exist in strong forms and shapes to independently promote science and health issues. As a combined result of all these, in addition to other factors such as high economic costs, people in developing countries do not have much access to informal science communication platforms that are taken for granted in advanced

societies – such as science museums, science cafes, exhibitions, festivals of learning, and so on. Thus, as soon as they are out of formal education systems (which are themselves often slow in keeping up with the pace of science), the only existent and accessible channel for them to keep themselves informed of and engaged with S&T and its related issues is the news media. If done well, science journalism would be instrumental for Vietnamese ordinary public to make better S&T decisions for development causes and to avoid the potential trap of undesirable, unsustainable techno-deterministic progress and growth. This suggestion was highly raised by participants, particularly those with appropriate understanding of science journalism.

- First and foremost, all science practitioners must have a proper understanding of science journalism and its contribution to national development. Any of journalist effort could not be achieved if the newsroom managers, scientists and policy makers do not appreciate the important role of science journalism [C3].
- In the era of misinformation, such as the Covid-19 infodemic, informed and critical science reporting is even more important because it can help the public not to get lost in the massive amount of data and opinions available on the Internet. [B9]

Despite its central role to enhance public understanding of science, journalism cannot alone solve all science communication missions. Science journalism can only be done well if its work is developed in tandem with other means of science communication. As aforementioned, science communication remains underdeveloped in Vietnam, due to the reluctance of science stakeholders to communicate science. Thus, it is necessary for all science stakeholders, especially science researchers, to perceive S&T communication as a critical part of their work. They should be equipped with good scientific communicating skills, and know-how to make science understandable and reachable to wider public. New alternative media, i.e. website, blog, and social networks (Facebook, Instagram, Twister) could be appropriate platform for academic scholar communicate their works and ideas directly, quickly and efficiently with ordinary audience. The flourishing of scientists' personal Facebook pages during Covid-19 pandemic, and the preliminary success of

Factcheckvn, a fact-checking channel on TikTok platform run by Vietnam News Agency shed a light for the effective use of alternative media to enhance science communication in Vietnam. If it is done well, it would work in corporation with science journalism to increase public understanding of and engagement in science process, and thereby, foster the national developmental goals.

- ***Improving the science and media literacy among the public***

As argued above, science journalism cannot alone solve all science communication problems. In tandem with other means of science communication, science journalism can only contribute to the development if science audience – those who is expected to absorb science knowledge from the news media – becomes a key participant in the science communication process. Research show that different sociodemographic groups of audience exhibit different perception of, interest in, expectation towards and distinct level of participation in science media (Rogers 2000, Schafer et al. 2018). Particularly, the least educated group are often less interested in science. They rarely access science in forms of books or the internet but merely from television commercial or radio advertisement (Schafer et al. 2018). This finding is echoed by our interviewed journalists who widely agree that low science literacy in Vietnam has diminished journalism's effort to bring science to the public. While the public is not interested in S&T and lacks knowledge to assess science content, the chain of science communication may be broken. Taking the role of the public into account, this thesis suggests several strategies to enhance the public science literacy through formal and informal education might improve their interest in S&T. It thereby might be effective in bridging the gap between science journalism and its public. A long-life and active participation of the public in science communication would be a good driving force for science journalism to professionalism.

However, it should be considered that in the age of a changing nature of information, ordinary people can bypass mainstream news to access any science content, in its digital forms, such as science blogs and forums. As a partial consequence, lay public is flooded in uncertainty, even fake news and misinformation. Thus, it is vital for every individual to be a critical science reader who can independently assess the validity and credibility of various science sources. In tandem with science literacy, enhancing news literacy through formal and informal training should be a key

strategy for public to make wise choices towards the science information absorbing from the internet. In Vietnam, an US-Embassy funded project to develop news literacy for undergrade and high school student has been established since 2017³⁹. The project which is based on a news literacy curriculum developed by journalism instructors at Stony Brook University has provided training workshop for nearly 10,000 college and high school students in the south of Vietnam (VNU-Faculty of Journalism and Communication 2017). Although there is no evidence about its success, this programme is expected to train the young public how to consume news properly (Uyen Diep 2019).

The transformation of media environment as well as the changing news audience behaviour from traditional to other online and social platform requires, at the same time, provides an opportunity for journalism to transform itself from a mere science disseminator to curator, particularly, convener, public intellectual and civic educator (Fahy and Nisbert 2021). In this context, journalists must improve their capacity to provide a more diverse and interactive ways of telling science stories in order to serve the public need. Training, coaching, as will be discussed in the next section, would be one of the most important and practical solution.

- ***Capacity building is the first crucial step to improve science journalism***

Alongside a strong recognition of science journalism, the active participation of public in science issues, capacity building through specialist education and training in conjunction with professional networking would be the first step to a better future of science journalism in Vietnam. Despite participants in this research were not in high consent of how to structure an effective training system for Vietnamese science journalists, it was widely agreed that a change in media curricula is needed. The two most popular complaints by participants who graduated from journalism schools for the ineffective media training in Vietnam are (1) the obsolescent media theories adapted from Russian Soviet decades ago and (2) the lack of specialist journalism training, including science journalism. A senior editor who was former journalism lecturer admitted the inadequacy of available teaching in Vietnamese universities with practical demand of the news industry: “There is a long distance between university and newsroom. What journalists learn from schools are unpractical and

³⁹ The author was a former fellow of this project

they need to be re-trained when entering the news industry” [A2]. It was echoed by another journalist that students are not trained to be specialist reporters. She even exclaimed that “you shouldn’t daydream about university journalism in Vietnam” [C3]. However, both of them, in accord with other interviewees, showed a thirst for a fundamental training to improve journalists’ skills to cover specialist areas.

- Journalism programmes at universities should provide several modules, such as economic reporting or science reporting, for students to have adequate knowledge and skills to deal with these specialist aspects. When students are equipped with such basic foundation, they would be able to consider whether their ability and skills are appropriate for science, economic or other specialist areas of journalism. [A2]
- It is very important to have specialist training for editors because they need to be the first persons to perceive the importance of science journalism. From there, they will transmit their values and strategy to their junior staff. [C3]

Ideally, enhancing science journalism training in universities could satisfy the demand of more specialist science journalists. Although it is a “long way ahead” for a radical and comprehensive reform of journalism education and training in Vietnam, there are good signals that science journalism (along with environment journalism) has been designed as a compulsory or optional module at the BA in journalism provided by the National University of Vietnam and The University of Danang⁴⁰. However, it should be noted that, there is a shortage of experts who can provide efficient science journalism training in Vietnam. Other interviewees, thus, suggested a mentoring program or in-house coaching as further initiatives to improve the quality of science journalism. This was particularly welcomed among the former mentees of the WFSJ’s SjCOOP Asia project. Regardless of several shortages, SjCOOP was mentioned as a successful model for science journalism training. An editor expressed his satisfaction to a staff journalist whom he sent to SjCOOP due to his progress in not only science reporting skills but also his vision and mindset to lead science journalism in the newspaper. “It is an obvious advancement, like he is reborn. He expresses more concern on science, particularly agricultural science.

⁴⁰ The author who is a lecturer at The University of Danang, has, along with her colleagues, recently designed the new BA in journalism curriculum in which science journalism is a compulsory module

Moreover, his reporting is much deeper, thanks to knowledge definitely achieved from this project”, commented the manager [A2]. Initial successes of SjCOOP bring strong hopes and high expectations as well as offer some rare insights into how journalism training and education initiatives such as SjCOOP Asia might help to improve science journalism and what they should do to ensure success in Vietnam and other countries of the Global South.

In fact, the six SjCOOP-trained journalists who responded to this study shared several worthy points to consider both for Vietnam and other developing countries:

First, capacity building must be based on continual training from the basic to the advanced with a clear long-term vision and sustainable strategy. “There must be a process, step by step, for the journalists to know science journalism first and follow its principles later. It should start from the very basic”. Particularly, media universities could adopt the science-based modules of SjCOOP into their existing bachelor programmes. Even journalists who are more specially trained with a scientific background and experienced in the newsroom are frequently challenged in covering the big science stories. Short workshop and seminars specializing on specific topics are expected to support them to deal with current issues.

Second, mentoring-based training should be customised for each trainee through the design of “learning by doing”. SjCOOP is evident for the success of the model “learning from practicing”. The six in-depth interviewees who had gone through the SjCOOP Asia training were especially enthused about the experience of being trained with an international professional body, professional training syllabus and expertise trainers are promising for the prospect of training success.

Third, training should reach not only the newsroom staff but also the editor board, and, over time, the whole news industry. As long as the concept of science journalism is well perceived by the editors and the newsroom managers, fundamental views and principles on good science journalism are widely shared by the whole news industry, the effect of training attempt will last long beyond its lifetime.

With that such long-term and short-term trainings, science journalism could overcome many internal challenges from within the news industry to concentrate on

dealing with the many challenges from outside, ultimately for the sake of more professionalism and more sustainable development in less advantaged parts of Asia. A widely recognized success achieved from SjCOOP training is the network formed between the members throughout the process. Networking is expected to play an instrumental role in promoting/spreading the good (and discrediting/eliminating the bad) in science journalism, attracting new members and, perhaps most importantly at this early stage, convincing news executives of the normative and economic values of science journalism. This is a point that many of the SjCOOP participants also made in the interviews.

However, the attempt to set up a club or network, recruit new members to push science journalism ahead more quickly and more sustainably in Vietnam is an uneasy goal. Two key members of SjCOOP project admitted their failings to build the Vietnamese Association of Science Journalist. One shared her experience that “at the starting point, people are effervescent, but after a while, I don’t see any updates” [C2]. The tiny number of well-trained science journalists might be a drop into an ocean and most are not news executives to be heard in Vietnamese newsrooms. The best solution to take science journalism professionalism to the next level, raised by our interviewees, is the synchronised change from top to down. “The must be policy to enhance the value of science and technology journalism. Change would not be achieved if effort is only made by journalists ourselves” [B3]. And perhaps this is a plea for international organizations, such as the World Federation of Science Journalists, to consider and continue to discuss with its potential funders in the months and years ahead. Perhaps, a second stage of SjCOOP Asia – with many more mentees in and beyond the current participating countries and more frequent and substantive interactions with local newsrooms – is the next step to build developing Vietnam into a stronghold of professional science journalism.

- ***A drastic change in editorial approaches to science and technology topics is required for developmental causes.***

Once both news managers and executives have appropriate knowledge and expertise to deal with S&T and its involved controversies, there are further initiatives that the newsroom should consider to ensure its contribution to the developmental goals.

First, there should be a gradual reduction of an excessive reliance on foreign sources, especially Western news media in science news output. The media more attention to AI as found in Chapter 6 suggests a possibility of available local source for science news stories. Otherwise, international science stories should be glocalised appropriately to local context, ensuring foreign S&T development relevant to indigenous citizen's daily life.

Second, there should be a more considered balance between news values and science norms and standards in the socio-economic and political framing of science discoveries and issues, especially controversial ones. It means that instead of heavily depending on scientific source, journalists should take a more media-led strand, a more critical approach to science, especially science risks and benefit. Science reporting should be based on weight of evidence rather than enmeshing to the 'gee-whiz' techno-innovations or healthcare breakthroughs or hyping the disputes between scientific vested groups to secure a place in the news headline.

Third, there should be more mutual trust and understanding between local science institutions and news organisations, a more cooperative, more effective working partnership with local scientists and science-related organisations. If the relationship between scientific community and the media is not tighten, the above efforts can hardly be achieved.

7.3. Call for further research

This thesis is a timely contribution to the still very limited understanding of science journalism in the Global South. In addition to presenting a specific perspective from a particular country, the work contributes substantially to the literature on media representation of global scientific controversies in the developing world. By employing two science issues, GMO and AI, it provides several observations on how global S&T travel across the globe and how Western-developed scientific issues presented in the Southern media.

This study, being of a mixture of in-depth interviews and content analysis, suggests a number of opportunities for future research. In the literature, news representation of science has been primarily studied through content or discourse analysis. This research has shown that such representation could be more thoroughly examined

through understanding two components: science news output and the socio-professional factors that affect the production of such content. While science news content is visible and can be explored by content or discourse analysis, science news production is less visible and can be obtained through other approaches, such as interviews or observational methods. In this thesis, in-depth interviews were used as an appropriate method to explore how science news producers perceive and practice science reporting. Further research could take this point to probe into other science stakeholders in the South, i.e. scientific researcher and manager, PR agent, politician who are acknowledged in our research that have substantial influence on science journalism professionalism.

In addition, the coding scheme can be a useful reference for similar content analysis in the field. Although a majority of variables were adopted from previous studies of science in the news, several new variables were added to make the coding more relevant to the context of a developing country and the study's focus on controversies over science issues (i.e. risk/benefit, localisation). This would contribute substantially to a conceptual framework of media representation and provides a coding scheme for future research to explore how news media in Vietnam and beyond respond to other cases, i.e. debate over vaccination, stem cell research or Coronavirus. The study could be extended in longitudinal and comparative studies or applied in different case studies. For example, further research into Vietnamese science journalism could take our data as a historical perspective to make evaluation on the possible change of science journalism over time, to explore whether and to which extent science journalists and editors shift in perception and skills to do science journalism. Comparative research could also use our content analysis findings to access the differences between the representation of science controversies in Vietnamese new media (AI or GMO) and in other media systems (e.g. China, UK or US), or the differences between print, online, social media presentation of S&T controversies.

The thesis, however, has several limitations that could be improved in the future. First, the concept of media representation presented in Chapter 4 reveals that along with the science reporters and editors, other stakeholders, i.e. scientists, policy makers, economic corporations, science activists and so on, have substantial

influence on science reporting. This thesis has carried out in-depth interviews with news reporters and editors but, within a limited scope, has not probed into other stakeholders. Thus, it lacks empirical viewpoints from outside the newsroom, who could give this research a more balanced assessment about the relationship between science reporters and non-news stakeholders. Exploring the status of science journalism from both inside and outside news industry would fill in a big gap in science media research, which has paid more attention to science coverage. Second, science news audiences were not taken as an object in our study. Future research may explore how Vietnamese ordinary people approach to science news to have a more comprehensive evaluation of its contribution to their knowledge and responses towards S&T developments. Third, regarding content analysis, the sample size was limited in two years 2017 and 2018, thus unable to provide a historical snapshot of science journalism in Vietnam. Future research would take a longitudinal approach to explore the trend of science in the news, analysing the development of science journalism through the media history. Moreover, the sample was collected by using Google database which would have missed science news output from other media, e.g. television, radio, print. Future research would address this limitation for a better understanding of science journalism in Vietnam and its implications for development in this country in particular and in the Global South in general.

BIBLIOGRAPHY

Ahmed, A., 2005. *Barriers to science journalism in Pakistan* [online]. Available from: <http://www.scidev.net/global/author.aleem-ahmed.html> [Accessed 10 Oct 2016].

Allan, S., 2011. Introduction: Science journalism in a digital age. *Journalism*, 12 (7), 771–777.

Allan, S., Anderson, A., and Petersen, A., 2010. Framing risk: nanotechnologies in

- the news. *Journal of Risk Research* [online], 13 (1), 29–44. Available from: <https://doi.org/10.1080/13669870903135847>.
- Allgaier, J., Dunwoody, S., Brossard, D., Lo, Y.-Y., and Peters, H. P., 2013. Journalism and Social Media as Means of Observing the Contexts of Science. *BioScience*, 63, 284–287.
- Amu, J. C. and Agwu, A. E., 2012. Attitude and Knowledge of Print Media Journalists towards Reporting of Climate Change News in Nigeria. *Journal of Agricultural Extension*, 16 (2), 52–67.
- Anderson, A., 2017. *Source Influence on Journalistic Decisions and News Coverage of Climate Change*. Oxford Research Encyclopedia of Climate Science.
- Anderson, A., Allan, S., Petersen, A., and Wilkinson, C., 2005. The Framing of Nanotechnologies in the British Newspaper Press. *Science Communication* [online], 27 (2), 200–220. Available from: <https://doi.org/10.1177/1075547005281472>.
- Angler, M. W., 2017. *Science Journalism An introduction*. New York: Routledge.
- Annan, K., 2003. A Challenge to the World's Scientists. *Science*. New York, 1485.
- Appiah, B., Gastel, B., and Burdine, J. N., 2012. The future of science journalism in Ghana: evidence based perspectives. *Journal of Science Communication*, 11 (1).
- Appiah, B., Gastel, B., JN, B., and LH, R., 2015. Science reporting in Accra, Ghana: Sources, barriers and motivational factors. *Public understanding of Science*, 24 (1), 23–37.
- Appleyard, B., 1999. *Brave New Worlds: Genetics and the Human Experience*. London. London, UK: Harper Collins.
- Aram, A., 2011. The fallacy of balance in communicating climate change. *Media Development*, 4/2011, 24–27.
- Arujanan, M., 2011. Malaysia Biotechnology Awareness: From the Ivory Towers to the Masses. In: Hautea, R. A., ed. *Communication Challenges and Convergence in Crop Biotechnology*. Los Baños, Philippines: International Service for the Acquisition of Agri-biotech Applications (ISAAA): Ithaca, New York and SEAMEO Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA).
- Ashe, T., 2013. *How the Media Report Scientific Risk and Uncertainty: A Review of the Literature*. University of Oxford - The Reuters Institute of Study of Journalism.
- Ashorkhani, M., Gholami, J., Maleki, K., Nedjat, S., Mortazavi, J., and Majdzadeh, R., 2012. Quality of health news disseminated in the print media in developing countries: a case study in Iran. *BMC Public Health*, 12, 627–634.
- Ashwell, D. J., 2016. The challenges of science journalism: The perspectives of scientists, science communication advisors and journalists from New Zealand. *Public Understanding of Science*, 25 (3), 379–393.
- Asiyanb, A. P., 2015. 'I don't get this climate stuff!' Making sense of climate change among the corporate middle class in Lagos. *Public understanding of Science*, 24 (8), 1007–1024.
- Asoro, R. L. S., 2012. The effects of press freedom and biotech policy on Southeast Asian newspapers' coverage of genetically modified crops. *Graduate College*. Iowa State University, USA.

- Augoustinos, M., Crabb, S., and Shepherd, R., 2010. Genetically modified food in the news: Media representations of the GM debate in the UK. *Public understanding of science*, 19, 98–114.
- Aykut, S. C., Comby, J.-B., and Guillemot, H., 2012. Climate change controversies in French mass media 1990–2010. *Journalism Studies* [online], 13 (2), 157–174. Available from: <https://doi.org/10.1080/1461670X.2011.646395>.
- Badenschier, F. and Wormer, H., 2012. Issue Selection in Science Journalism: Towards a Special Theory of News Values for Science News? In: Rödger, S., Franzen, M., and Weingart, P., eds. *The Sciences' Media Connection – Public Communication and its Repercussions*. London: Springer, 59–85.
- Bakker, P., 2012. The rise of free daily newspapers in Latin America. *Revista de Communication*, 11, 129–149.
- Balaban, M., Hester, P., and Diallo, S., 2015. Towards a theory of multi-method M&S approach: Part III. In: *Proceedings of the 2015 Winter Simulation Conference* [online]. 2015. Available from: <http://weekly.cnbnnews.com/news/article.html?no=124000>.
- Balleh, A., 2012. *Misconceptions in science journalism: African experience* [online]. Available from: <http://www.scidev.net> [Accessed 10 Oct 2016].
- Bauer, M., 2002. Controversial medical and agri-food biotechnology: A cultivation analysis. *Public understanding of science*, 11, 93–111.
- Bauer, M. and Gaskell, G., 2002. *Biotechnology: The Making of a Global Controversy*. Cambridge University Press - The Science Museum, London.
- Bauer, M., Ragnarsdottir, Asdis Rudolfsdottir, A., and Durant, J., 1995. *Science and Technology in the British Press, 1946-1990: A systematic content analysis of the press*. The Science Museum, London, UK.
- Bauer, M. W., Yulye Jessica, Ramos, R., Massarani, L., Amorim, L., and Howard, S., 2013. *Global science journalism report: working conditions & practices, professional ethos and future expectations*. Our learning series , Science and Development Network. London, UK: London School of Economics and Political Science.
- Bawa, A. S. and Anilakumar, K. R., 2013. Genetically modified foods: safety, risks and public concerns-a review. *Journal of food science and technology*, 50 (6), 1035–1046.
- BBC, 2017. *Google AI defeats human Go champion* [online]. Available from: <https://www.bbc.co.uk/news/technology-40042581> [Accessed 13 Dec 2019].
- Beck, U., 1992. *Risk Society: Towards a New Modernity* [online]. London, UK: SAGE Publications. Available from: <https://books.google.com.vn/books?id=QUdMaGICuEQC>.
- Bertrand, J. T., O'Reilly, K., Denison, J., Anhang, R., and Sweat, M., 2006. Systematic review of the effectiveness of mass communication programs to change HIV/AIDS-related behaviors in developing countries. *Health Education Research*, 21 (4), 567–597.
- Billett, S., 2010. Dividing climate change: global warming in the Indian mass media. *Climatic Change*, 99, 1–16.
- Borowiec, S. and Lien, T., 2016. *AlphaGo beats human Go champ in milestone for*

- artificial intelligence* [online]. Los Angeles Times. Available from: <https://www.latimes.com/world/asia/la-fg-korea-alphago-20160312-story.html> [Accessed 13 Aug 2019].
- Bostrom, N. and Müller, V., 2014. Future Progress in Artificial Intelligence : A Survey of Expert Opinion. In: Müller, V. C., ed. *Fundamental Issues of Artificial Intelligence*. Berlin: Springer.
- Botelho, D. and Kurtz, H., 2008. The introduction of genetically modified food in the United States and the United Kingdom: A news analysis. *Social Science Journal - SOC SCI J*, 45, 13–27.
- Bowe, B. J., Oshita, T., Terracina-Hartman, C., and Chao, W.-C., 2012. Framing of climate change in newspaper coverage of the East Anglia e-mail scandal. *Public Understanding of Science* [online], 23 (2), 157–169. Available from: <https://doi.org/10.1177/0963662512449949>.
- Boykoff, M., 2010. Indian media representations of climate change in a threatened journalistic ecosystem. *Climatic Change*, 99, 17–25.
- Brante, T. and Elizinga, A., 1990. Towards a theory of scientific controversies. *Science studies*, 2, 33-46.
- Brennen, A. J. S., Howard, P. N., and Nielsen, R. K., 2018. *An Industry-Led Debate : How UK Media Cover Artificial Intelligence*. Reuters Institute for the Study of Journalism, 1–10.
- Brumfiel, G., 2009. Supplanting the old media? *Nature*, 458 (7236), 274–277.
- Bryman, A., 2012. *Social Research Methods*. 4th ed. The United States: Oxford University Press.
- Bucchi, M. and Mazzolini, R., 2003. Big science, little news: science coverage in the Italian daily press 1946-1997. *Public understanding of Science*, 12, 7–24.
- Bughin, J., Seong, J., Manyika, J., Chui, M., and Joshi, R., 2018. *Modeling the global economic impact of AI*. McKinsey Report [online], (September), 1–61. Available from: <https://www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-modeling-the-impact-of-ai-on-the-world-economy>.
- Cacciatore, M. A., Anderson, A. A., Choi, D.-H., Brossard, D., Scheufele, D. A., Liang, X., Ladwig, P. J., Xenos, M., and Dudo, A., 2012. Coverage of emerging technologies: A comparison between print and online media. *New Media & Society* [online], 14 (6), 1039–1059. Available from: <https://doi.org/10.1177/1461444812439061>.
- Carlétti, C. and Massarani, L., 2015. Explainers of science centres and museums: a study on these stakeholders in the mediation between science and the public in Brazil. *Journal of Science Communication*, 13 (2).
- Castelfranchi, Y., Massarani, L., and Ramalho, M., 2013. War, anxiety, optimism and triumph: a study on science in the main Brazilian TV news. *Journal of Science Communication*, 13 (3).
- Castro, D. and New, J., 2016. *The Promise of Artificial Intelligence* [online]. Washington DC. Available from: datainnovation.org [Accessed 10 June 2019].
- Castro, P. and Gomes, I., 2005. Genetically modified organisms in the Portuguese press: Thematization and anchoring. *Journal for the Theory of Social Behaviour*, 35

(1), 1–17.

Chitturu, S., Lin, D.-Y., Sneader, K., Tonby, O., and Woetzel, J., 2017. *Artificial Intelligence and Southeast Asia's Future*. McKinsey Global Institute produced for Singapore Summit 2017 [online], (September), 1–30. Available from: https://sci-hub.tw/https://doi.org/10.1007/978-3-030-12453-3_151.

Chong, M., Shanahan, J., Brossard, D., and Ngo, N., 2004. Elite Asian Newspaper Coverage of Agricultural Biotechnology. *International Communication Association Conference*. New Orleans 27-31 May 2004.

Chow, E. K., 2019. *China's GMO Paradox* [online]. The Diplomat. Available from: <https://thediplomat.com/2019/05/chinas-gmo-paradox/> [Accessed 10 Oct 2020].

Chuan, C., Tsai, W. S., Gables, C., Gables, C., and Gables, C., 2019. Framing Artificial Intelligence in American Newspapers. In *Proceedings of AAAI/ACM Conference on Artificial Intelligence, Ethics, and Society (AIES'19)*. January 27-28, 2019, Honolulu, HI, USA 339–344.

Columbia University Mailman School of Public Health, 2019. *Content Analysis* [online]. Available from: <https://www.publichealth.columbia.edu/research/population-health-methods/content-analysis> [Accessed 1 Jan 2019].

Cook, G., Robbins, P. T., and Pieri, E., 2006. Words of Mass Destruction: British Newspaper Coverage of the Genetically Modified Food Debate, Expert and Non-expert Reactions. *Public Understanding of Science*, 15, 5–19.

Crawley, C., 2007. Localized Debates of Agricultural Biotechnology in Community Newspapers: A Quantitative Content Analysis of Media Frames and Sources. *Science Communication*, 28(3), pp. 314–346. doi: [10.1177/1075547006298253](https://doi.org/10.1177/1075547006298253).

Creswell, J. W. and Clark, V. L. P., 2011. Choosing a mixed methods design. In: *Designing and Conducting Mixed Methods Research*. The United State: SAGE Publications Inc.

Cui, D. and Wu, F., 2019. The influence of media use on public perceptions of artificial intelligence in China: Evidence from an online survey. *Information Development*, 1–13.

Cui, K. and Shoemaker, S. P., 2018. Public perception of genetically-modified (GM) food: A Nationwide Chinese Consumer Study. *Science of Food* [online], 2 (1), 1–8. Available from: <http://dx.doi.org/10.1038/s41538-018-0018-4>.

Cyranoski, D., 2019. *The CRISPR-baby scandal: what's next for human gene-editing* [online]. Nature. Available from: <https://www.nature.com/articles/d41586-019-00673-1> [Accessed 10 Oct 2020].

Damien, P. and Guy, V. D. E., 2020. *The EU legislation of GMO: Overview* [online]. 2010. Available from: <https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/eu-legislation-gmo-overview> [Accessed 10 Oct 2020].

Dang, T. T. H., 2012. Vietnamese model of journalism in the age of integration and its effects to the civil society and democracy in Vietnam. *VNU Journal of Social Sciences and Humanities* 28 (5E), 57-64.

Dao, Q. L., 2017. *Truyền thông về khoa học và công nghệ trên báo điện tử (Science and technology communication in online newspaper)*. Vietnam National University, Ha Noi.

- Das, J., 2012. Environmental journalism in Bangladesh Active social agency. *Journalism Studies*, 13 (2), 226–242.
- Davidson, L., 2019. *Narrow vs. General AI: What's Next for Artificial Intelligence?* [online]. Available from: <https://www.springboard.com/blog/narrow-vs-general-ai/> [Accessed 17 Jun 2020].
- DeRosier, C., Sulemana, I., Jr, H. S. J., Corinne Valdivia, Folk, W., and Smith, R. D., 2015. A comparative analysis of media reporting of perceived risks and benefits of genetically modified crops and foods in Kenyan and international newspapers. *Public understanding of Science*, 24 (5), 563–581.
- Devereux, E., 2007. Analysing Media Content: Media -“Re-presentations” in a Divided World. In: Devereux, E., ed. *Understanding the media*. London: Sage.
- Dharmaraj, S., 2019. Artificial Intelligence (AI) is developing rapidly in Vietnam. *Vietnam Insider* [online], 30 August 2019. Available from: <https://vietnaminsider.vn/artificial-intelligence-ai-is-developing-rapidly-in-vietnam/>. [Accessed 10 Oct 2020].
- Dickson, D., 2012. *Debate erupts over whether science journalists must have a background in science* [online]. Available from: <https://scidevnet.wordpress.com/2012/09/20/debate-erupts-over-whether-science-journalists-must-have-a-background-in-science/> [Accessed 10 Oct 2020].
- Dijk, T. A. van, 1995. Opinions and Ideologies in Editorials. In: *The 4th International Symposium of Critical Discourse Analysis* [online]. Athens: Language, Social Life and Critical Thought. Available from: [http://www.discursos.org/unpublished/articles/Opinions and ideologies in editorials.htm](http://www.discursos.org/unpublished/articles/Opinions%20and%20ideologies%20in%20editorials.htm). [Accessed 10 Oct 2020].
- Ding, H. and Kong, Y., 2019. Constructing Artificial Intelligence in the U.S. and China: A Cross-Cultural, Corpus-Assisted Study. *China Media Research*, 15 (1), 93–105.
- Dinh, T.T.H., 2004. Vietnamese medio: Contradictions between Party media and market forces. *Journal of International Communication*, 10(1), 79-92.
- Du, L. and Rachul, C., 2012. Chinese newspaper coverage of genetically modified organisms. *BMC Public Health*, 12 (236).
- Duhigg, C., 2018. *The Case Against Google: Critics say the search giant is squelching competition before it begins. Should the government step in?* [online]. The New York Times. Available from: <https://www.nytimes.com/2018/02/20/magazine/the-case-against-google.html> [Accessed 12 Dec 2019].
- Dunwoody, S., 1999. Scientists, journalists, and the meaning of uncertainty. In: Friedman S.,M., Dunwoody, S., Roger, C.L. *Communicating uncertainty*. The United States: Lawrence Erlbaum Associates.
- Dunwoody, S., 2014. Science journalism. In: Buchi, M. and Trench. *Routledge Handbook of Public Communication of Science and Technology*. 2nd ed.. London, UK: Routledge Handbooks.
- Durant, J., Bauer, M. W., and Gaskell, G., 1998. *Biotechnology in the public sphere: A European Sourcebook*. London: Science Museum.
- Durfee, J. and Corbett, J., 2004. Testing Public (Un)Certainty of Science Media

- Representations of Global Warming. *Science Communication*, 26, 129–151.
- Dutt, B., 2012. Biomedical research coverage in English-language Indian newspapers. *Journal of Scientometric Research*, 1 (1), 71–78.
- Dutt, B. and Garg, K. C., 2000. An overview of science and technology coverage in Indian English-language dailies. *Public understanding of Science*, 9, 123–140.
- Dutt, B. and Garg, K. C., 2012. S&T coverage in English-language Indian dailies. *Journal of Science Communication*, 11 (3).
- Ebeling, M. F. E., 2008. Mediating Uncertainty: Communicating the Financial Risks of Nanotechnologies. *Science Communication* [online], 29 (3), 335–361. Available from: <https://doi.org/10.1177/1075547007312068>.
- Ekanem, I. A., 2003. Communicating science information in a science-unfriendly environment: the experience of Nigeria. *Public understanding of Science*, 12, 203–209.
- Elmer, C., Badenschier, F. and Wormer, H., 2008. Science for everybody? How the coverage of research issues in German newspaper has increased dramatically. *Journalism & Mass Communication Quarterly*, 85(4), 878-893.
- Engelhardt H., T. and C. A. L., 1989. Patterns of controversy and closure: the interplay of knowledge, values, and political forces. In: Engelhardt H., T. and C. A. L., ed. *Scientific controversies* (2nd edition). The United State: Cambridge University Press.
- Entman, R. M., 1993. Framing : Toward Clarification of a Fractured Paradigm. *Journal of Communication*, 43 (4), 51–58.
- ESCAP - United Nations, 2017. *Artificial Intelligence in Asia and the Pacific* [online]. Available from: <https://www.unescap.org/resources/artificial-intelligence-asia-and-pacific> [Accessed 10 Oct 2020].
- Evans, S., 2015. Journalistic Norms, Cultural Values, and Coverage of Climate Change in the Philippines. *Environmental Communication*, 10 (4), 492–507.
- Fackson, B., 2002. *Can beggars be choosers?* [online]. Panos London. Available from: <http://panoslondon.panosnetwork.org/features/can-beggars-be-choosers/> [Accessed 10 Oct 2020].
- Faggella, D., 2019. *What is Artificial Intelligence? An Informed Definition* [online]. Emerj. Available from: <https://emerj.com/ai-glossary-terms/what-is-artificial-intelligence-an-informed-definition/> [Accessed 12 Apr 2019].
- Fahy, D. and Nisbet, M. C. 2021, The science journalist online: Shifting roles and emerging practices. *Journalism*, 12(7), 778-793.
- Fang, X., 2014. Local people's understanding of risk from civil nuclear power in the Chinese context. *Public understanding of Science*, 23 (3), 283–298.
- FAO, 2003. *Weighing the GMO arguments: for* [online]. Available from: <http://www.fao.org/english/newsroom/focus/2003/gmo7.htm> [Accessed 15 Feb 2020].
- Farr, A. C., Witte, K., Jarato, K., and Menard, T., 2006. The Effectiveness of Media Use in Health Education: Evaluation of an HIV/AIDS Radio Campaign in Ethiopia.

Health Communication, 10 (3), 225–235.

Fast, E. and Horvitz, E., 2017. Long-term trends in the public perception of artificial intelligence. *31st AAAI Conference on Artificial Intelligence, AAAI 2017*, (January 1986), 963–969.

FDA, 2020. *Science and history GMO and other food modification processes* [online]. Available from: <https://www.fda.gov/food/agricultural-biotechnology/science-and-history-GMO-and-other-food-modification-processes> [Accessed 10 Oct 2020].

Fleck, L., 1979. *Genesis and Development of a Scientific Fact*. Chicago: Chicago University Press.

Fox, F. and Collis, T., 2010. *Science and the Media : Securing the Future*. Science and the Media Expert Group.

Franklin, B., Hame, M., H., M., Kinsey, M., and Richardson, J. E., 2005. *Key concepts in Journalism Studies*. London: Sage.

Freeman, B. C., 2017. Claims, Frames, and Blame: Coverage of Climate Change in ASEAN's English- Language Newspapers, 2002-2012. *Sage Open*, 1–12.

Freudenthal, G., 1998. Controversy. *Science in Context*, 11 (2), 155–160.

Friedman, S. and Egolf, B., 2005. Nanotechnology: Risks and the Media. *Technology and Society Magazine, IEEE*, 24, 5–11.

Friedman, S. and Egolf, B., 2011. A longitudinal study of newspaper and wire service coverage of nanotechnology risks. *Risk Analysis*, 31 (11), 1701–1717.

Friedman, S. M., Dunwoody, S., and Rogers, C. L., 1999. *Communicating Uncertainty: Media Coverage of New and Controversial Science* [online]. Erlbaum Associates. Available from: <https://books.google.com.vn/books?id=W8Ute8VA2pUC>. [Accessed 10 Oct 2020].

Funk, C., Gottfried, J., and Mitchell, A., 2017. *Science News and Information Today*. PEW Research Centre.

Funk, C., Tyson, A., Kennedy, B., Johnson, C., and Research, S., 2020. *Biotechnology Research Viewed With Caution Globally, but Most Support Gene Editing for Babies To Treat Disease* [online]. Available from: www.pewresearch.org. [Accessed 10 Oct 2020].

Garces, P., 2006. Genetically modified crops 2.0: The decline of media controversy in digital journalism. *Science Studies Journal*, 6, 28–34.

Garvey, C. and Maskal, C., 2020. Sentiment Analysis of the News Media on Artificial Intelligence Does Not Support Claims of Negative Bias Against Artificial Intelligence. *OMICS A Journal of Integrative Biology*, 24 (5), 286–299.

Geary, J., Camicioli, E., and Bubela, T., 2016. DNA barcoding in the media: does coverage of cool science reflect its social context? *Genome*, 59 (9), 738–750.

Gilbert, B., 2019. *Google reportedly manipulates search results to hide controversial subjects and favor big business* [online]. Insider. Available from: <https://www.businessinsider.com/google-manipulates-search-results-report-2019-11?r=US&IR=T> [Accessed 20 Dec 2019].

Goertzel, T., 2014. The Path to more general artificial intelligence. *Journal of Experimental & Theoretical Artificial Intelligence*, 26 (3).

- Goode, E. and Ben-Yehuda, N., 2009. *Moral Panics: The Social Construction of Deviance*, 2nd ed. Singapore: Wiley/Blackwell.
- Görke, A. and Ruhrmann, G., 2003. Public Communication between Facts and Fictions: On the Construction of Genetic Risk. *Public Understanding of Science*, 12, 229–241.
- Guenther, L., Froehlich, K., and Ruhrmann, G., 2015. (Un)Certainty in the News: Journalists' Decisions on Communicating the Scientific Evidence of Nanotechnology. *Journalism & Mass Communication Quarterly*, 92 (1), 199–220.
- Guenther, L. and Ruhrmann, G., 2013. Science journalists' selection criteria and depiction of nanotechnology in German media. *Journal of Science Communication*, 12 (3).
- Guenther, L. and Ruhrmann, G., 2016. Scientific evidence and mass media: Investigating the journalistic intention to represent scientific uncertainty. *Public Understanding of Science*, 25.
- Gutteling, J. M., 2002. Biotechnology in the Netherlands: controversy or consensus? *Public Understanding of Science* [online], 11 (2), 131–142. Available from: <https://doi.org/10.1088/0963-6625/11/2/303>.
- Hall, D. W. and Pesenti, J., 2017. *Growing the artificial intelligence industry in the UK* [online]. Available from: <https://www.gov.uk/government/publications/growing-the-artificial-intelligence-industry-in-the-uk> [Accessed 12 Jan 2019]
- Hall, S., 1997. The world of representation. In: Hall, S., ed. *Representation: Cultural representations and signifying practices*. London, UK: SAGE Publications.
- Hallin, D. C. and Mancini, P., 2004. *Comparing media systems: Three models of media and politics*. New York: Cambridge University Press.
- Hallin, D. C. and Mancini, P., 2012. *Comparing media systems beyond the Western World*. USA: Cambridge University Press
- Han, J., Sun, S., and Lu, Y., 2017. Framing Climate Change: A Content Analysis of Chinese Mainstream Newspapers from 2005 to 2015. *International Journal of Communication*, 11, 2889–2911.
- Harker, D., 2015. *Creating Scientific Controversies Uncertainty and Bias in Science and Society*. Cambridge: Cambridge University Press.
- Hibberd, M. and Nguyen, A., 2013. Climate change communications & young people in the Kingdom: a reception study. *International Journal of Media and Cultural Politics*, 9 (1), 27–46.
- Hibino, A. and Nagata, M., 2006. Biotechnology in the Japanese media: Comparative analysis of newspaper articles on genetic engineering in Japan and Europe. *Asian Journal of Social Psychology*, 9, 12–13.
- Hien, T. Le and Navarro, M. J., 2011. Vietnam: Paving the Way for Greater Awareness and Understanding of Biotechnology. In: *Communication Challenges and Convergence in Crop Biotechnology* [online], 224–243. Available from: http://www.isaaa.org/resources/publications/communication_challenges_and_conver

gence_in_crop_biotechnology/default.asp.

Hin, L. T. W. and Subramaniam, R., 2014. Role of Learned Societies in Communicating Science. *Communicating Science to the Public: Opportunities and Challenges for the Asia-Pacific Region*. Netherlands: Springer.

Hoang Anh, 2014. Vietnam aims to raise public awareness of GMOs. [online], 26 September 2014. Available from: <https://www.vir.com.vn/vietnam-aims-to-raise-public-awareness-of-gmos-30586.html> [Accessed 1 Jan 2020].

Hofstede Insights, 2020. *Hofstede insight: Vietnam* [online]. Available from: <https://www.hofstede-insights.com/country/vietnam/> [Accessed 1 Jan 2020].

Holliman, R., 2004. Media coverage of cloning: A study of media content, production and reception. *Public Understanding of Science*, 13 (2), 107–130.

Huang, C., 2003. Transitional media vs Normative theories: Schramm, Altschull, and China. *Journal of Communication* (September 2003), 444-459.

ISAAA, 2019. *Executive Summary Biotech Crops Drive Socio-Economic Development and Sustainable Environment in the New Frontier* [online]. Available from: <https://www.isaaa.org/resources/publications/briefs/55/executivesummary/default.asp>. [Accessed 1 Jan 2020].

Jajal, T. D., 2018. *Distinguishing between Narrow AI, General AI and Super AI* [online]. Available from: <https://medium.com/@tjajal/distinguishing-between-narrow-ai-general-ai-and-super-ai-a4bc44172e22> [Accessed 17 Jun 2020].

Jaspal, R. and Nerlich, B., 2012. When climate science became climate politics: British media representations of climate change in 1988. *Public Understanding of Science* [online], 23 (2), 122–141. Available from: <https://doi.org/10.1177/0963662512440219>.

Jia, H. and Liu, L., 2014. Unbalanced progress: The hard road from science popularisation to public engagement with science in China. *Public understanding of Science*, 23 (1), 32–37.

Johnson, R. B., Onwuegbuzie, A. J., and Turner, L. A., 2007. Toward a Definition of Mixed Methods Research. *Journal of Mixed Methods Research* [online], 1 (2), 112–133. Available from: <https://doi.org/10.1177/1558689806298224>.

Joshi, A., 2018. Science journalism and communication in India: Challenges. *International Journal of Current Advanced Research 2* [online], 7 (2), 10374–10379. Available from: <http://www.journalijcar.org>.

Joshi, N., 2019. *How Far Are We From Achieving Artificial General Intelligence?* [online], 2019. Available from: <https://www.forbes.com/sites/cognitiveworld/2019/06/10/how-far-are-we-from-achieving-artificial-general-intelligence/#679f74d46dc4>. [Accessed 1 Jan 2020]

Joubert, M., 2007. South Africa: Building capacity. In: Bauer, M. W. and Bucchi, M., eds. *Journalism, Science and Society*. New York: Routledge.

Jurberg, C., Verjovsky, M., Cardoso Machado, G. de O., and Affonso-Mitidieri, O. R., 2009. Embryonic stem cell: A climax in the reign of the Brazilian media. *Public Understanding of Science* [online], 18 (6), 719–729. Available from:

<https://doi.org/10.1177/0963662509335457>.

Jurberg, C., Verjovsky, M., Machado, G. de O. C., and Affonso-Mitidieri, O. R., 2009. Embryonic stem cell: A climax in the reign of the Brazilian media. *Public understanding of Science*, 18 (6), 719–729.

Kakonge, J. O., 2011. The role of Media in the Climate Change Debate in Developing Countries. *Global Policy Essay*, November 2.

Kakonge, J. O., 2012. Fostering Partnerships With Media Organizations to Improve Climate Change Coverage in Africa. *Science communication*, 35 (3), 411–416.

Karembu, M., Nguthi, F., Nabusoba, T., Oriare, P., Nyangaga, J., Schaeffer, H., and Myers, M., 2011. *Dimensions of Radio Coverage and Content Generation of Agricultural Biotechnology News in Kenya* [online]. Available from: <https://idl-bnc-idrc.dspacedirect.org/bitstream/handle/10625/47085/133460.pdf?sequence=1&isAllowed=y>. [Accessed 1 Jan 2020]

Karembu, M., Otunge, D., Arujanan, M., Liew, K. C., Choudhary, B., Gaur, K., Choudhary, M. I., Purwantara, B., Panopio, J., Lapitan, R., Noel Amano, J., Hamid, I. A., Nasiruddin, K., Attathom, S., Zhang, T., Zhang, H., Navarro, M. J., Tababa, S., and Le, H., 2009. *ISAAA Brief No. 40 - Communicating Crop biotechnology: stories from stakeholders*. Ithaca, NY.

Kehagia, O. and Chrysochou, P., 2007. The reporting of food hazards by the media: The case of Greece. *The Social Science Journal*, 44, 721–733.

Key, S., Ma, J. K.-C., and Drake, P. M., 2008. Genetically modified plants and human health. *Journal of the Royal Society of Medicine* [online], 101 (6), 290–298. Available from: <https://pubmed.ncbi.nlm.nih.gov/18515776>.

Kim, L., 2011. Media framing of stem cell research: A cross-national analysis of political representation of science between the UK and South Korea. *Journal of Science Communication*, 10, 1–16.

Kim, S.-H., Kim, H., and Oh, S.-H., 2014. Talking About Genetically Modified (GM) Foods in South Korea: The Role of the Internet in the Spiral of Silence Process. *Mass Communication & Society*, 17, 713–732.

Kirkpatrick, A., 2019. A Emergent realization: US and UK Newspaper Coverage of Artificial Intelligence. In: *International Communication Conference*. Washington DC, 1–45.

Kohring, M. and Matthes, J., 2002. The face(t)s of biotech in the nineties: how the German press framed modern biotechnology. *Public understanding of science*, 11, 143–154.

Krøvel, R., 2012. Setting the Agenda on Environmental News in Norway Setting the Agenda on Environmental News in Norway. *Journalism Studies*, 13 (2), 37–41.

Kuppuswamy, S. and Maheswari, M. D., 2014. Climate change coverage in newspapers: A comparative study of The Hindu and The Times of India. *Indian Journal of Science Communication*, 13 (2), 3–15.

Kurzweil, R., 1993. The age of intelligent machines. *Mechanism and Machine Theory*, 28 (1).

Kwenda, J. C., 2013. Environmental NGOs as news sources: a sociological approach to the study of environmental journalism in South Africa. *Global media*

journal (African Edition), 7 (1), 67–91.

La, V.-P., Pham, T.-H., Ho, T., Nguyen, H., Nguyen, P., Vuong, T.-T., Nguyen, H. K., Ho, T., and Vuong, Q.-H., 2020. Policy response, social media and science journalism for the sustainability of the public health system amid the COVID-19 outbreak: The Vietnam lessons. *Sustainability* 2020, 12(7), 2931.

Le, H. T. and Navarro, M. J., 2011. Vietnam Paving the Way for Greater Awareness and Understanding of Biotechnology. In: Navarro, M. J. and Hautea., R. A., eds. *Communication Challenges and Convergence in Crop Biotechnology*. Los Baños, Philippines: The International Service for the Acquisition of Agri-biotech Applications (ISAAA) and SEAMEO Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA).

Lee, K.-F., 2018. *Understanding Our AI Future* [online]. Medium. Available from: <https://medium.com/@kaifulee/understanding-our-ai-future-6c414b9c9763> [Accessed 25 Jun 2020].

Leinonen, A. and Kivisaari, S., 2010. *Nanotechnology perceptions. Literature review on media coverage, public opinion and NGO perspectives*. VTT Technical Research Centre of Finland.

Lemańczyk, S., 2014. Science and National Pride: The Iranian Press Coverage of Nanotechnology, 2004-2009. *Science communication*, 36 (2), 194–218.

Lewenstein, B. V., Gorss, J., and Radin, J., 2005. No Title The Saliency of Small: Nanotechnology Coverage in the American Press, 1986-2004. In: *International Communication Association*. New York.

Li, Y., Luo, C., and Chen, A., 2019. The evolution of online discussions about GMOs in China over the past decade: Changes, causes and characteristics. *Cultures of Science*, 2 (4), 311–325.

Ligami, C. M., 2016. *Print Media Coverage of the Ban on Importation of Genetically Modified Foods in Kenya: a Content Analysis of Daily Nation and the East African*. University of Nairobi.

Linke, S., 2011. Contexts constrain science in the public: How the sociobiology debate was (not) presented in the German press. *Public Understanding of Science* [online], 21 (6), 740–758. Available from: <https://doi.org/10.1177/0963662510394250>.

Listerman, T., 2010. Framing of science issues in opinion-leading news: international comparison of biotechnology issue coverage. *Public Understanding of Science* [online], 19 (1), 5–15. Available from: <https://doi.org/10.1177/0963662505089539>.

Lo, Y.-Y. and Peter, H. P., 2015. Taiwanese life scientists less “medialized” than their Western colleagues. *Public understanding of Science*, 24 (1), 6–22.

Locksley, G., 2009. *The Media and Development: What's the story?* World Bank. No. 158. Washington, D.C.

Lopera Pareja, E. and Moreno Castro, C., 2014. The uncertainties of climate change in Spanish daily newspapers: Content analysis of press coverage from 2000 to 2010. *Journal of Science Communication*, 13.

Lore, T. A., 2011. *An analysis of the coverage of genetically modified crops by mainstream Kenyan print media: the case of the Daily Nation, the standard and Taifa*

Leo, 2007-2009. University of Nairobi, Kenya.

Lu, L., 2017. *Framing Genetically-modified Foods Communication in China: A Content Analysis of News Coverage of People's Daily and Southern Metropolis*. University of South Florida.

Lü, L., 2009. The value of the use of biotechnology: public views in China and Europe. *Public Understanding of Science*, 18, 481–492.

Lublinski, J., Reichert, I., Augustin, D., Jean-Marc, F., Labassi, O., and Spurk, C., 2014. Advances in African and Arab science journalism: Capacity building and new newsroom structures through digital peer-to-peer support. *Ecquid Novi: African Journalism Studies*, 35 (2), 4–22.

Lugo-Ocando, J. and Nguyen, A., 2017. *Developing News*. London: Routledge.

Macdonald, S. and Headlam, N., 2009. *Research Methods Handbook: Introductory Guide to Research Methods for Social Research*. Centre for Local Economic Strategies.

Mackenzie, D., 1994. *Europe pushes for a genetically modified future* [online]. New Scientist. Available from: <https://www.newscientist.com/article/mg14219290-600-europe-pushes-for-a-genetically-modified-future/> [Accessed 1 Feb 2020].

Maesele, P., 2013. Risk conflicts, critical discourse analysis and media discourses on GM crops and food. *Journalism* [online], 16 (2), 278–297. Available from: <https://doi.org/10.1177/1464884913511568>.

Maesele, P. A. and Schuurman, D., 2008. Biotechnology and the Popular Press in Northern Belgium: A Case Study of Hegemonic Media Discourses and the Interpretive Struggle. *Science Communication* [online], 29 (4), 435–471. Available from: <https://doi.org/10.1177/1075547008316221>.

Mai Duong, 2016. *Vietnam's news media and journalists in the internet age*. Thesis (PhD). University of Technology Sydney.

Malesky, E., 2020. Vietnam's automation future at work. *Vietnam Investment Review* [online], 23 May 2020. Available from: https://www.vir.com.vn/vietnams-automation-future-at-work-76355.html?fbclid=IwAR295dny_313aMnL82xmoQROS7aMY6BKv-E2HID7IHZOH2kDIJXYAP8hoOA. [Accessed 1 Feb 2020]

Manyika, J., Chui, M., and Bughin, J., 2013. *Disruptive technologies: Advances that will transform life, business, and the global economy*. McKinsey Global Institute [online], Available from: http://www.mckinsey.com/insights/business_technology/disruptive_technologies%5Cnhttp://www.chrysalixevc.com/pdfs/mckinsey_may2013.pdf. [Accessed 1 Feb 2020]

Marks, L., Kalaitzandonakes, N., Wilkins, L., and Zakharova, L., 2007. Mass media framing of biotechnology news. *Public Understanding of Science*, 16, 183–203.

Marr, D., 1998. *The mass media in Vietnam*. Canberra: Panther Publishing and Press.

Masood, E., 2005. *The GM Debate – Who Decides? An analysis of decision-making about genetically modified crops in developing countries*. Panos Report. London: The Panos Unitution.

- Massarani, L., 2014. Science communication in Latin America: what is going on? *Science Museum Group Journal*, Autumn 201 (2).
- Massarani, L., 2015. Voices from other lands. *Public understanding of Science*, 24 (1), 2–5.
- Massarani, L. and Buys, B., 2007. Science in the press in nine Latin American Countries. *Brazilian Journalism Research*, 3 (2), 77–96.
- Massarani, L., Buys, B., Amorim, L. H., and Veneu, F., 2005. Science Journalism in Latin America: A case study of seven newspapers in the region. *Journal of Science Communication*, 4 (3).
- McMullin, E., 1987. Scientific controversy and its termination. In: JR, H. T. E. and CAPLAN, A. L., eds. *Scientific controversies*. Cambridge University Press.
- McNair, B., 2005. Who are Journalists?. In: Burgh, H. ed. *Making Journalists Diverse Models, Global Issues* 1st ed. New York: Routledge, 25-43.
- Mellor, F., Webster, S., and Bell, A. R., 2011. *Content Analysis of the BBC's Science Coverage*. Appendix A of BBC Trust Review of Impartiality and Accuracy of the BBC's Coverage of Science.
- Mercado-Martinez, F., Robles-Silva, L., Moreno-Leal, N., and Franco-Almazan, C., 2001. Inconsistent Journalism: The Coverage of Chronic Diseases in the Mexican Press. *Journal of Health Communication*, 6, 235–247.
- Mercado, M. T., 2012. Media representations of climate change in the Argentinean press. *Journalism Studies*, 13 (2), 193–209.
- Michael, E. J. and Binta, O. D., 2013. Reportage of Science and Environmental Issues In Selected Nigerian Newspapers. *The International Journal Of Science & Technoledge*, 1 (6), 22–27.
- Midttun, A., Coulter, P., Gadzekpo, A., and Wang, J., 2015. Comparing media framings of climate change in developed, rapid growth and developing countries: Finding from Norway, China and Ghana. *Energy and Environment*, 26 (8), 1271–1292.
- Ministry of Science and Technology, 2012. *The Strategy for Science and Technology Development for the 2011-2020 period*.
- Mochahari, M., 2013. Revisiting India's science communication and journalism-issues and challenges. *Global Media Journal – Indian Edition*, 4 (1), 1–14.
- Moghariya, D. P. and Smardon, R. C., 2014. Rural perspectives of climate change: A study from Saurashtra and Kutch of Western India. *Public understanding of Science*, 23 (6), 660–677.
- Van Montagu, M. and Burssens, S., 2000. Why Do We Need Genetically Modified Plants? *Developments in Plant Genetics and Breeding*, 6, 13–15.
- Mozur, P., 2017. *Beijing Wants A.I. to Be Made in China by 2030*. The New York Times. Available from <https://www.nytimes.com/2017/07/20/business/china-artificial-intelligence.html> [Accessed 06 Dev 2020].
- Mueller-Herbst, J. M., Xenos, M. A., Scheufele, D. A., and Brossard, D., 2020. Saw It on Facebook: The Role of Social Media in Facilitating Science Issue Awareness. *Social Media + Society* [online], 6 (2). Available from:

<https://doi.org/10.1177/2056305120930412>.

Mueller, J. P. and Massaron, L., 2018. *Artificial Intelligence*. New Jersey: John Wiley & Sons, Inc.

Mula, S., 2007. *Finding Golden Rice in the GMO arena: The framing of Golden Rice and agricultural biotechnology in Philippine newspapers*. SAAS - Agricultural Communications Section.

Müller, V. C. and Bostrom, N., 2016. Future Progress in Artificial Intelligence : A Survey of Expert Opinion. *Fundamental Issues of Artificial Intelligence*, 1, 553–571.

Mumba, L. E., 2007. Food Aid Crisis and Communication about GM Foods: Experience from Southern Africa. In: Brossard, D., Shanahan, J., and Nesbitt, T. C., eds. *The public, the media and agricultural biotechnology*. The United Kingdom: Biddles Ltd, Kings Lynn, 338–364.

Murcott, T. H. L. and Williams, A., 2012. The challenges for science journalism in the UK. *Progress in Physical Geography*, 37 (2), 152–160.

Mwale, P. N., 2006. Societal deliberation on genetically modified maize in southern Africa: the debateness and publicness of the Zambian national consultation on genetically modified maize food aid in 2002. *Public understanding of Science*, 15, 89–102.

Naicker, I., 2015. *The role of science in reaching development goals* [online]. The Conversation. Available from: <https://theconversation.com/the-role-of-science-in-reaching-development-goals-42071> [Accessed 27 May 2018].

National Academies of Science Engineering and Medicine, 2016. *Genetically Engineered Crops*. Washington, DC: National Academies of Science, Engineering and Medicine.

National Academy of Sciences, 2017. *The nature of science related public controversies* [online]. National Academies Press. Available from: <https://www.nap.edu/read/23674/chapter/5> [Accessed 10 Oct 2020].

Navarro, M. J. and Hautea, R. A., 2011. *Communication Challenges and Convergence in Crop Biotechnology*. Los Baños, Philippines.

Navarro, M. J., Panopio, J. A., and Malayang, D. B., 2011. Print media reportage of agricultural biotechnology in the Philippines: a decade's (2000-2009) analysis of news coverage and framing. *Journal of Science Communication*, 10 (3).

Navarro, M. and Villena, M., 2004. Media monitoring of agri-biotechnology in the Philippines: understanding the biotech debate. *The Philippine Agricultural Scientist*, 87, 439–451.

Ndlovu, H., Joubert, M., and Boshoff, N., 2016. Public science communication in Africa: views and practices of academics at the National University of Science and Technology in Zimbabwe. *Journal of Science Communication*, 15 (6).

Nelkin, D., 1987. The culture of science journalism. *Society* 24, 17–25 [Online]. Available at: <https://doi.org/10.1007/BF02695570> [Access: 15/03/2021]

Nelkin, D., 1992. *Controversy, politics of technical decisions (3rd ed)*. The USA: Sage.

- Nelkin, D., 1995. *Selling Science How the press covers science and technology*. New York: W.H. Freeman and Company.
- Neresini, F., 2000. And Man Descended from the Sheep: The Public Debate on Cloning in the Italian Press. *Public Understanding of Science*, 9, 359–382.
- Ngo, L. C., 2003. Assessments of the needs in biotechnology applications in Vietnam. *Omonrice*, 11, 10–27.
- Nguyen-Tan, D., 2012. *The Strategy for Science and Technology Development for the 2011-2020 period* [online]. Available from: <https://www.most.gov.vn/en/news/146/the-strategy-for-science-and-technology-development-for-the-2011-2020-period.aspx>.
- Nguyen-Thu, G., 2018. Vietnamese Media Going Social: Connectivism, Collectivism, and Conservatism. *The Journal of Asian Studies*, 77, 895–908.
- Nguyen, A. 2009, Citizen journalism in Vietnam – Technologies, democracy and the nation-state in a globalised news environment, In: Allan, S. and Thorsen, E. (eds), 2009. *Citizen Journalism: Global Perspectives 1*, New York: Peter Lang.
- Nguyen, A., 2014. *The current status of science journalism in Southeast Asia*. Research Report Prepared on behalf of World Federation of Science Journalists for the International Development Research Centre.
- Nguyen, A. and McIlwaine, S., 2011. Who wants a voice in science issues - and why? A European survey and its implications for science journalism. *Journalism Practice*, 5, 210–226.
- Nguyen, A. and Tran, M., 2019. Science journalism for development in the Global South: A systematic literature review of issues and challenges. *Public Understanding of Science*, 28(8), pp. 973–990
- Nguyen Dinh, C., 2013. *Một số hạn chế về thông tin khoa học và công nghệ trên báo chí: Hiện trạng và giải pháp* [Several limitations of S&T news: issues and solutions] [online]. Song tre. Available from: <http://songtre.com.vn/news/tin-noi-bat/mot-so-han-che-ve-thong-tin-khoa-hoc-va-cong-nghe-tren-%0D%0Abao-chi-hien-trang-va-giai-phap-49-6318.html> [Accessed 15 Aug 2020].
- Nguyen, H. and Nguyen, A., 2020. Covid-19 misinformation and the social (Media) amplification of risk: A Vietnamese perspective. *Media and Communication*, 8 (2), 444–447.
- Nichols, S. and Chase, N., 2005. A Content Analysis of Health Research Reported by the Daily Newspapers of Trinidad and Tobago. *West Indian Medical Journal*, 54 (5), 308–314.
- Niekerk, P. van and Villiers, P. de, 2020. *Battling misinformation: The rise of science journalism during Covid-19* [online]. Available from: <https://whatsnewinpublishing.com/battling-misinformation-the-rise-of-science-journalism-during-covid-19/> [Accessed 12 Feb 2021].
- Nisbet, M. C. and Hoge, M., 2006. Attention Cycles and Frames in the Plant Biotechnology Debate: Managing Power and Participation through the Press/Policy Connection. *Harvard International Journal of Press/Politics* [online], 11 (2), 3–40. Available from: <https://doi.org/10.1177/1081180X06286701>.
- Nisbet, M. C. and Lewenstein, B. V, 2002. Biotechnology and the American Media:

- The Policy Process and the Elite Press, 1970 to 1999. *Science Communication* [online], 23 (4), 359–391. Available from: <https://doi.org/10.1177/107554700202300401>.
- Normile, D., 2019. *Chinese scientist who produced genetically altered babies sentenced to 3 years in jail* [online]. Sciencemag.org. Available from: <https://www.sciencemag.org/news/2019/12/chinese-scientist-who-produced-genetically-altered-babies-sentenced-3-years-jail> [Accessed 1 Jan 2020].
- Nucci, M. L. and Kubey, R., 2007. ‘we begin tonight with fruits and vegetables’: Genetically modified food on the evening news 1980-2003. *Science Communication*, 29 (2), 147–176.
- O’Mahony, P. and Schäfer, M. S., 2005. The ‘Book of Life’ in the press: comparing German and Irish media discourse on human genome research. *Social studies of science*, 35 (1), 99–130.
- Ogbogu, U., Du, L., Rachul, C., Bélanger, L., and Caulfield, T., 2013. Chinese Newspaper Coverage of (Unproven) Stem Cell Therapies and their Providers. *Stem Cell Rev and Rep*, 9, 111–118.
- Okafor, O. E. and Okafor, P. I., 2017. Membership of cooperative society and adoption of agricultural technology in Awka North LGA of Anambra State, Nigeria. *Journal of Agriculture and Biodiversity Research*, 6, 1–11.
- Olajide, R. and Fawole, P., 2015. Coverage and content analysis of biotechnology and genetically modified organisms in four selected Nigerian daily newspapers. *Tropical Agricultural Research and Extension*, 16, 81.
- Olet, P. and Othieno, J., 2015. How to do mass media publicity for a neglected disease. Lessons from Tsetse and Trypanosomiasis in Kenya. *Journal of Science Communication*, 14 (03).
- Omeje, C., 2019. *Media coverage and framing of genetically modified crops: A case study of science journalism in Nigeria*. Stellenbosch University.
- Onishi, N., 2011. ‘Safety Myth’ Left Japan Ripe for Nuclear Crisis [online]. The New York Times. Available from: <https://www.nytimes.com/2011/06/25/world/asia/25myth.html> [Accessed 15 Jan 2020].
- Ouchchy, L., Coin, A., and Dubljevi, V., 2020. AI in the headlines: the portrayal of the ethical issues of artificial intelligence in the media. *Open Forum*, March 2020.
- Outram, S. M., 2010. Science communication in Sub-Saharan Africa; The case of GMOs. *Journal of International Development*, 22, 341–352.
- Panopio, J. A. and Navarro, M. J., 2011. Philippines: Drama and Communication Behind Asia’s First Commercialized Bt Corn. In: Hautea, R. A., ed. *Communication Challenges and Convergence in Crop Biotechnology*. Los Baños, Philippines.: International Service for the Acquisition of Agri-biotech Applications (ISAAA): Ithaca, New York and SEAMEO Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA).
- Parliament Office of Science and Technology, 2004. *Scientific capacity in developing countries* [online]. Available from: <https://www.parliament.uk/globalassets/documents/post/postpn216.pdf> [Accessed

15 Jan 2020].

Patairiya, M., 2007. Challenges and Prospects of Science Communication in South Asia. *Indian Journal of Science Communication*, 6 (1), 9–16.

Patairiya, M., 2014. Science Journalism in India. *Science Journalism in India* [online], 2/16/2014. Available from: <http://www.pantaneto.co.uk/issue25/patairiya.htm>.

Patil, D. M., 2011. Recent trends of print media in development communication. *Global Media Journal (Indian Edition)*, 2 (2).

PEW, 2015. *Public and Scientists' Views on Science and Society*. Pew research centre.

Pham, H. D., 2007. *Climate change coverage by the Vietnamese media* [online]. Available from: <https://earthjournalism.net/images/documents/climate-change-coverage-by-the-vietnamese-media-2007-baseline-assessment> [Accessed 10 May 2018].

Pham, M. T., Francic, M., and Petlock, B., 2018. *Vietnam Agricultural Biotechnology Annual* [online]. Available from: [https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=Agricultural Biotechnology Annual_Hanoi_Vietnam_10-22-2018.pdf](https://apps.fas.usda.gov/newgainapi/api/report/downloadreportbyfilename?filename=Agricultural%20Biotechnology%20Annual_Hanoi_Vietnam_10-22-2018.pdf). [Accessed 15 Jan 2020].

Pham Thu, T., 2011. *Vấn đề chính sách REDD+ được thể hiện trong thông tin đại chúng Nghiên cứu điểm tại Việt Nam*. Working Paper 53. CIFOR, Bogor, Indonesia.

Pham, V. T., 2018. *Country Status Reports on Agricultural Biotechnology - Vietnam* [online]. Bangkok. Available from: <https://www.slideshare.net/apaari/country-status-reports-on-agricultural-biotechnology-vietnam>. [Accessed 15 Jan 2020].

Phan, K. S., 2008. *Vietnam is improving science communication*. Scidev. Available from: <https://www.scidev.net/global/opinions/vietnam-is-improving-science-communication/> [Accessed 20 Jan 2019].

Plantinga, B., 2012. Newspaper publishing. In: Myburgh, V., Smith, E., Liebenberg, S., and Jager, L. de, eds. *South African entertainment and media outlook: 2012-2016*. South Africa: PricewaterhouseCoopers, 171–189.

Pratt, C. B. and Ha, L., 2002. Setting the Public Health Agenda on Major Diseases in Sub-Saharan Africa: African Popular Magazines and Medical Journals, 1981–1997. *International Communication Association*, 52 (4), 889–904.

Priest, S. H., 2001. Cloning: A study in news production. *Public Understanding of Science*, 10 (1), 59–69.

Priest, S. H. and Ten Ecyk, T., 2003. News coverage of biotechnology debates. *Society*, 40 (6), 29–34.

Ramalho, M., Massarani, L., and Polino, C., 2012. From the laboratory to prime time: science coverage in the main Brazilian TV newscast. *Journal of Science Communication*, 11 (2).

Reis, R., 2008. How Brazilian and North American Newspapers Frame the Stem Cell Research Debate. *Science communication*, 29 (3), 316–334.

Ren, J., Peters, H. P., and Lo, Y.-Y., 2014. Similar challenges but different responses: Media coverage of measles vaccination in the UK and China. *Public*

understanding of Science, 23 (4), 366–375.

Rensberger, B., 2009. Science journalism: Too close for comfort, *Nature*, 459 (7250), 1055-1056.

Rodriguez, L. and Lee, S., 2016. What Can Be Gleaned From News Coverage to Improve Science Reporting and Enhance Public Literacy About Agricultural Biotechnology in Ghana? *Journal of Agricultural & Food Information* [online], 17 (2–3), 91–109. Available from: <https://doi.org/10.1080/10496505.2015.1133309>.

Rogers, C. L., 2000. Making the audience a key participant in the science communication process. *Science and Engineering Ethics* (6), 553-557.

Romps, D. M. and Retzinger, J. P., 2019. Climate news articles lack basic climate science. *Environmental Research Communications* [online], 1 (8), 81002. Available from: <http://dx.doi.org/10.1088/2515-7620/ab37dd>.

Roux, M. Le, 2016. *Rise of the Machines: Keep an eye on AI, experts warn* [online]. Available from: <https://phys.org/news/2016-03-machines-eye-ai-experts.html> [Accessed 12 Mar 2019].

Roux, M. Le and Mollard, P., 2016. *Game over? New AI challenge to human smarts*. Available from: <https://phys.org/news/2016-03-game-ai-human-smarts.html>. [Accessed 12 Mar 2019]

Rowe, G., Frewer, L., and Sjöberg, L., 2000. Newspaper reporting of hazards in the UK and Sweden. *Public Understanding of Science* [online], 9 (1), 59–78. Available from: <https://doi.org/10.1088/0963-6625/9/1/304>.

Ruan, Y., Yang, J., and Jin, J., 2019. One issue, different stories: The construction of GMO issues on Chinese, American and British mainstream media portals. *Cultures of Science* [online], 2 (4), 255–275. Available from: <https://doi.org/10.1177/209660831900200403>.

Russell, C., 2010. Covering Controversial Science: Improving Reporting on Science and Public Policy. In: Kennedy, D. and Overholser, G., eds. *Science and the Media*. Cambridge, MA: American Academy of Arts and Sciences, 13–43.

Russell, S. J. and Norvig, P., 1995. *Artificial Intelligence: A modern Approach*. New Jersey: Prentice Hall.

Saffell, N., 2016. *“The best or worst thing to happen to humanity” - Stephen Hawking launches Centre for the Future of Intelligence* [online]. Available from: <https://www.cam.ac.uk/research/news/the-best-or-worst-thing-to-happen-to-humanity-stephen-hawking-launches-centre-for-the-future-of> [Accessed 6 Sep 2019].

Sameer, B., 2020. *What is narrow AI & how it is different from artificial general intelligence?* [online]. Available from: <https://analyticsindiamag.com/what-is-narrow-ai-how-it-is-different-from-artificial-general-intelligence/> [Accessed 17 Jun 2020].

Sarathchandra, D. and McCright, A. M., 2017. The Effects of Media Coverage of Scientific Retractions on Risk Perceptions. *SAGE Open* [online], 7 (2). Available from: <https://doi.org/10.1177/2158244017709324>.

Schafer, M. S., 2010. Taking stock: a meta-analysis of studies on the media’s coverage of science. *Public understanding of Science* [online], 1–14. Available from: <https://www.researchgate.net/deref/http%3A%2F%2Fpus.sagepub.com%2Fcontent>

%2Fearly%2F2010%2F11%2F27%2F0963662510387559.

Schäfer, M. S., Füchslin, T., Metag, J., Kristiansen, S. and Rauchfleisch, A., 2018, The different audiences of science communication: A segmentation analysis of the Swiss population's perceptions of science and their information and media use patterns. *Public Understanding of Science*, 27(1) [Online], Available at: <https://journals.sagepub.com/doi/10.1177/0963662517752886> [Accessed: 15/03/2021]

Schanne, M., Spurk, C., and Wawira, J., 2009. *Feasibility Study 'Enabling Health Journalism'*. Zurich University: School of Applied Linguistics IAM Institute of Applied Media Studies Research.

Scheufele, D. A. and Tewksbury, D., 2007. Framing, Agenda Setting, and Priming: The Evolution of Three Media Effects Models. *Journal of Communication*, 57, 9–20.

Secko, D. M., Friday, T., and Amend, E., 2013. Four models of science journalism: A synthesis and practical assessment. *Journalism Practice*, 7 (1), 62–68.

Şener, S. and Saridoğan, E., 2011. The effects of science-technology-innovation on competitiveness and economic growth. *Procedia - Social and Behavioral Sciences*, 24, 815–828.

Shackley, S. and Wynne, B., 1996. Representing Uncertainty in Global Climate Change Science and Policy: Boundary-Ordering Devices and Authority. *Science, Technology, & Human Values*, 21 (275–302).

Shanahan, M., 2006. Fighting a reporting battle. *Nature*, 443, 392.

Shanahan, M., 2009. Time to Adapt? Media Coverage of Climate Change in Nonindustrialised Countries. *Climate Change and the Media*, 145–157.

Shehata, A. and Hopmann, D. N., 2012. Framing climate change. *Journalism Studies* [online], 13 (2), 175–192. Available from: <https://doi.org/10.1080/1461670X.2011.646396>.

Sheldon, I., 2002. Regulation of biotechnology: Will we ever 'freely' trade GMOs? *European Review of Agricultural Economics*, 29, 155–176.

Shih, T.-J., Wijaya, R., and Brossard, D., 2008. Media Coverage of Public Health Epidemics: Linking Framing and Issue Attention Cycle Toward an Integrated Theory of Print News Coverage of Epidemics. *Mass Communication & Society*, 11, 141–160.

Shrestha, S., Burningham, K., and Grant, C. B., 2014. Constructions of Climate Change on the Radio and in Nepalese Lay Focus Groups. *Environmental Communication*, 8 (2), 161–178.

Siebert, F. S., Peterson, T., Schramm, W., 1956. *Four theories of the press*. USA: University of Illinois Press.

Society of Professional Journalists (SPJ), 2021. *Codes of ethics* [Online]. Available at: <https://www.spj.org/pdf/spj-code-of-ethics.pdf> [Accessed: 15/03/2021].

- Statista, 2020. *Global cotton production 2019/2020, by country* [online]. Available from: <https://www.statista.com/statistics/263055/cotton-production-worldwide-by-top-countries/> [Accessed 10 Oct 2020].
- Statista, 2020. *Agriculture in Vietnam - Statistics & Facts* [online]. Available from: <https://www.statista.com/topics/5653/agriculture-in-vietnam/> [Accessed 10 Oct 2020].
- Stephens, L. F., 2005. News Narratives about Nano S&T in Major U.S. and Non-U.S. Newspapers. *Science Communication* [online], 27 (2), 175–199. Available from: <https://doi.org/10.1177/1075547005281520>.
- Stewart, C. and Kowaltke, A., 2007. Representation. In: STEWART (ed.). *In: Media new ways and meanings*. Australia: John Wiley & Sons Australia Ltd.
- Stocking, S. H., 1999. *How Journalists Deal With Scientific Uncertainty*. Communicating Uncertainty Media Coverage of New and Controversial Science. Mahwah, NJ: Lawrence Erlbaum.
- Stocking, S. H. and Holstein, L. W., 2008. Manufacturing doubt: journalists' roles and the construction of ignorance in a scientific controversy. *Public Understanding of Science* [online], 18 (1), 23–42. Available from: <https://doi.org/10.1177/0963662507079373>.
- Stray, J., 2010. *Why link out? Four journalistic purposes of the noble hyperlink* [online]. NiemanLab. Available from: <https://www.niemanlab.org/2010/06/why-link-out-four-journalistic-purposes-of-the-noble-hyperlink/> [Accessed 12 Jun 2019].
- Strekalova, Y. A., 2015. Informing dissemination research: A content analysis of U.S. newspaper coverage of medical nanotechnology news. *Science Communication*, 37 (2), 151–172.
- Subudhi, R., 2015. *Role of Print-Media in Socio-economic Development of East-India*.
- Sun, S., Zhai, Y., Shen, B., and Chen, Y., 2020. Telematics and Informatics Newspaper coverage of artificial intelligence : A perspective of emerging technologies, (September 2019).
- Tagbo, E., 2010. *Media Coverage of Climate Change in Africa A Case Study of Nigeria and South Africa*. University of Oxford: Reuters Institute Fellowship Paper University of Oxford.
- Tao, Z. and Shudong, Z., 2003. The Economic and Social Impact of GMO in China. *China Perspectives*, 47 (May-June 2003).
- The National Assembly of Vietnam, 2016. *Luat bao chi (Vietnamese Press Law)* [Online]. Available at: <https://mic.gov.vn/Upload/VanBan/Luat-bao-chi.signed.pdf> [Accessed: 15/03/2021].
- The Royal Society, 2018. *Portrayals and perceptuons of AI and why they matter*. London, UK.
- Thomas, M., 2019. *6 Dangerous risks of artifical intelligence* [online]. Available from: <https://builtin.com/artificial-intelligence/risks-of-artificial-intelligence> [Accessed 6 Sep 2019].
- Tolan, S., 2007. *Coverage of climate change in Chinese media (Fighting climate change: Human solidarity in a divided world)*. Human Development Report Office - UNDP.

- Torgersen, H., 2004. The real and perceived risks of genetically modified organisms. *EMBO reports* [online], 5 Spec No (Suppl 1), S17–S21. Available from: <https://pubmed.ncbi.nlm.nih.gov/15459729>. [Accessed 6 Sep 2019].
- Tran-Huu, Q., 2015. *Xa hoi hoc bao chi (Journalism Sociology)*. Hanoi: The Vietnam National University Publisher
- Tran, N. T., 1999. *Co so van hoa Vietnam (Vietnamese Culture Base)*. Vietnam: Education Publisher.
- Tran, T. Q., 2016. *Truyền thông về khoa học công nghệ trên đài truyền hình Việt Nam (Science and technology communication in Vietnamese national television)*. Vietnam National University, Ha Noi.
- Truman, H., 1949. *Inaugural Address* [online]. Inaugural Address. Available from: <https://www.trumanlibrary.gov/library/public-papers/19/inaugural-address> [Accessed 11 Oct 2019].
- Truong, D. T., 2019. *Perspectives on Vietnam's Science, Technology, and Innovation Policies*. Singapore: Palgrave Macmillan.
- Turchin, A. and Denkenberger, D., 2020. Classification of Global Catastrophic Risks Connected with Artificial Intelligence. *AI & SOCIETY volume*, 35, 147–163.
- Underwood, C., 2019. *Automated Journalism – AI Applications at New York Times, Reuters, and Other Media Giants* [online]. Available from: <https://emerj.com/ai-sector-overviews/automated-journalism-applications/> [Accessed 17 Jun 2020].
- UNESCO, 2007. *Developing a science journalism course for the developing countries*. A report on the UNESCO workshop and questionnaire conducted in association with the World Conference of Science Journalists, April 26-19-2007. Econnect CommunicationThe University of QueenslandBoston University.
- UNESCO, 2011. *Media coverage of science and technology in Africa*. Uganda: Makerere University.
- UNI Global, 2017. *Top 10 Principles for Ethical Artificial Intelligence* [online]. Available from: http://www.thefutureworldofwork.org/media/35420/uni_ethical_ai.pdf <http://www.thefutureworldofwork.org/opinions/10-principles-for-ethical-ai/> [Accessed 11 Oct 2019].
- Uyen Diep, 2019. Gioi tre Asean va cuoc chien chong tin gia (The Asean Youth and the fight against fake news). *ThanhNien Daily [Online]*. Available at: <https://thanhnien.vn/gioi-tre/gioi-tre-asean-va-cuoc-chien-chong-tin-gia-1132744.html> [Accessed: 15/03/2021].
- Uzelgun, M. A. and Castro, P., 2015. Climate Change in the Mainstream Turkish Press: Coverage Trends and Meaning Dimensions in the First Attention Cycle. *Mass Communication and Society*, 18, 730–752.
- Vakkuri, V. and Abrahamsson, P., 2018. The Key Concepts of Ethics of Artificial Intelligence. In: *Proceeding of 2018 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC)*. Stuttgart, Germany, July 2018.
- Veneu, F., Massarani, L., and Amorim, L. H., 2008. Science journalism in Latin America: how the scientific information from a scientific source is accommodated when it is transformed into a journalistic story. *Journal of Science Communication*, 7

(1).

Vergeer, M., 2020. Artificial Intelligence in the Dutch Press: An Analysis of Topics and Trends. *Communication Studies* 71(3), 373-392, DOI: 10.1080/10510974.2020.1733038

Vermeer, E. B. and Ho, P., 2004. Food Safety Concerns and Biotechnology: Consumers' Attitudes to Genetically Modified Products in Urban China. *AgBioForum*, 7 (4), 158–175.

VietnamNews, 2019. *Việt Nam faces challenges in developing AI* [online]. Available from: <https://vietnamnews.vn/economy/524079/viet-nam-faces-challenges-in-developing-ai.html> [Accessed 12 Dec 2019].

Vietnamese Press Association, 2016. *Vietnamese Journalists: Ten codes of ethics* [Online]. Available at: http://hoinhabaovietnam.vn/Cong-bo-10-dieu-Quy-dinh-dao-duc-nghe-nghiep-nguoi-lam-bao-Viet-Nam_n14748.html [Accessed: 15/03/2021].

VNU-Faculty of Journalism and Communication, 2017. *Call for application: 2017 Summer Institute for News literacy fellows in Asia to be held in Hochiminh city, August 1-3-2017* [Online]. Available at: <http://baochi.hcmussh.edu.vn/?ArticleId=c6ccc9ef-2fd1-4d08-bc4c-9ea0e9adad07> [Accessed: 15/03/2021].

Vu, D. Q., Chu, H. T., and Doan, T. T., 2004. *Current Status of Biosafety Regulations for GMOs in Vietnam*. ILSI Southeast Asia Region.

Vu, T. H., 2015. *Managing Vietnamese newsrooms: The role of internal communication*. Thesis (PhD). University of Westminster.

Wan IRFA, 2019. *World Press Trends 2019: Facts and Figures* [online]. Available from: <http://www.wptdatabase.org/world-press-trends-2017-facts-and-figures>. [Accessed 12 Dec 2019].

Wang, X. and Song, Y., 2020. Viral misinformation and echo chambers: the diffusion of rumors about genetically modified organisms on social media. *Internet Research* [online], 30 (5), 1547–1564. Available from: <https://doi.org/10.1108/INTR-11-2019-0491>.

Weaver, D. A. and Bimber, B., 2008. Finding News Stories: A Comparison of Searches Using LexisNexis and Google News. *Journal of Media and Communication Quarterly*, 85 (3), 515–530.

Wen, N. and Wei, R., 2018. Examining Effects of Informational Use of Social Media Platforms and Social Capital on Civic Engagement Regarding Genetically Modified Foods in China. *International Journal of Communication*, 12.

WHO, 2014. *Frequently asked questions on genetically modified foods*. Available from: <https://www.who.int/news-room/q-a-detail/food-genetically-modified>. [Accessed 12 Dec 2019].

Williams, A. and Clifford, S., 2009. *Mapping the field: Specialist science news journalism in the UK national media*. Cardiff: Cardiff University.

- Williams, K., 2011. *International Journalism*. London, England: Sage Publications.
- World Cancer Research Fund, 2018. *Liver cancer is the sixth most common cancer worldwide* [online]. Available from: <https://www.wcrf.org/dietandcancer/cancer-trends/liver-cancer-statistics> [Accessed 15 Mar 2018].
- Wunderlich, S. and Gatto, K. A., 2015. Consumer perception of genetically modified organisms and sources of information. *Advances in nutrition (Bethesda, Md.)* [online], 6 (6), 842–851. Available from: <https://pubmed.ncbi.nlm.nih.gov/26567205>.
- Wynn, J. and Walsh, L., 2013. Emerging Directions in Science, Publics, and Controversy. *Poroi*, 9 (1).
- Xu, Q., Yu, N., and Song, Y., 2018. User Engagement in Public Discourse on Genetically Modified Organisms: The Role of Opinion Leaders on Social Media. *Science Communication*, 40, 691–717.
- Zamith, R., Pinto, J., and Villar, M. E., 2012. Constructing Climate Change in the Americas: An Analysis of News Coverage in U.S. and South American Newspapers. *Science communication*, 35 (3), 334–357.
- Zhai, Y., Yan, J., Zhang, H., and Lu, W., 2020. Tracing the evolution of AI: conceptualization of artificial intelligence in mass media discourse, *Information Discovery and Delivery*, Vol. 48 No. 3, pp. 137-149.
- Zhang, J. Y., 2015. The ‘credibility paradox’ in China’s science communication: Views from scientific practitioners. *Public understanding of Science*, 24 (8), 913–927.
- Zhao, F., Chen, Y., Ge, S., Yu, X., Shao, S., Black, M., Wang, Y., Song, M., and Wang, W., 2014. A Quantitative Analysis of the Mass Media Coverage of Genomics Medicine in China: A Call for Science Journalism in the Developing World. *A Journal of Integrative Biology*, 18 (4), 222–230.
- Zhao, Y., Deng, H., Yu, C., and Hu, R., 2019. The Chinese public’s awareness and attitudes toward genetically modified foods with different labeling. *Science of Food* [online], 3 (1), 17. Available from: <https://doi.org/10.1038/s41538-019-0049-5>.
- Zhou, R., Wang, D., Siddiquei, A. N., Anwar, M. A., Hammad, A., Asmi, F., Ye, Q., and Nawaz, M. A., 2019. GMO/GMF on social media in China: Jagged landscape of information seeking and sharing behavior through a valence view. *International Journal of Environmental Research and Public Health*, 16 (23), 1–19.
- Zink, E., 2009. *Science in Vietnam*. Stockholm: International Foundation for Science.

APPENDIX 1

Interviewees

A. EDITORS

A1. Male, deputy editor-in-chief at Vietnamplus and Vietnam News Agency

A2. Male, senior editor at Tui tre (The Youth)

A3. Male, senior science and technology editor at Sai Gon Gia Phong (Sai Gon Revolution)

A4. Male, deputy editor-in-chief at Khoa hoc va Phat trien (Science and Development)

A5. Male, senior editor of the science and technology beat, Vietnamese Television Channel 9

A6. Male, head of representative office of Tien phong in the central of Vietnam, former subeditor of Tien phong (The Pioneer)

A7. Male, current affair senior editor at Zing.vn (Focus on COVID-19 reporting)

B. SCIENCE REPORTERS

B1. Male, science reporter at Thanh nien (Young People)

B2. Female, environmental reporter at the Metropolitan

B3. Female, science reporter at Dantri.

B4. Male, freelance science and technology reporter

B5. Male, science reporter at Tui tre (The Youth)

Appendix

B6. Female, reporter at Danang online news

B7. Male, reporter at VnExpress (Focus on COVID-19 reporting)

B8. Male, reporter at Tuoi tre (The Youth) (Focus on COVID-19 reporting)

B9. Male, reporter at Danang TV (Focus on COVID-19 reporting)

B10. Female, reporter at Thanh Nien (Young People) (Focus on COVID-19 reporting)

B11. Female, reporter at Tien phong (The Pioneer) (Focus on COVID-19 reporting)

B12. Male, reporter at Bao Da Nang (Danang Daily) (Focus on COVID-19 reporting)

B13. Female, reporter at Suc khoe va doi song (Health and Lifestyle) (Focus on COVID-19 reporting)

C. SCIENCE REPORTER – SJCOOP

C1. Female science journalist who left the news industry and is working as a PR official.

C2. Female science journalist, middle senior editor at Vietnamese News Agency

C3. Female science journalist who is working at Danviet - a newspaper of the Vietnamese Farmer Central Institution

C4. Male, science journalist at Tuoi tre (The Youth)

C5. Male, science/ environment journalist at Phap luat (The Law)

C6. Male, who is former science journalist at Vnexpress. He's now reporter at Thanh nien (The Young People)

APPENDIX 2

Sampling results

Key words	Computer 1 Author's macbook pro – Safari	Computer 2 Author personal desktop at BU – Firefox	Computer 3 Person 1's Macbook air – FireFox	Computer 4 Person 2's HP laptop - Cốc Cốc	Computer 5 Person 3's Acer laptop - Cốc Cốc	Computer 6 Person 4's Desktop - Chrome	Computer 7 Person 5's HP laptop - Chrome	Computer 8 Person 6's Dell laptop - Firefox	Computer 9 Person 7's Microsoft Surface – Chrome	Computer 10 Person 8's Ipad – Safari
Trí tuệ nhân tạo	20 pages	20 pages	20 pages	20 pages	20 pages	20 pages	20 pages	20 pages	20 pages	20 pages
	<u>Trường đại học trong thời đại trí tuệ nhân tạo</u>	<u>Trường đại học trong thời đại trí tuệ nhân tạo</u>	Trường đại học trong thời đại trí tuệ nhân tạo	Trường đại học trong thời đại trí tuệ nhân tạo	Trường đại học trong thời đại trí tuệ nhân tạo	Trường đại học trong thời đại trí tuệ nhân tạo	Trường đại học trong thời đại trí tuệ nhân tạo	Trường đại học trong thời đại trí tuệ nhân tạo	Trường đại học trong thời đại trí tuệ nhân tạo	Trường đại học trong thời đại trí tuệ nhân tạo
	<u>6 tháng, 4 mẫu smartphon e</u>	<u>EVN hợp tác với VNPay triển khai thanh toán tiền điện</u>	EVN hợp tác với Vnpay triển khai thanh toán tiền điện	EVN hợp tác với Vnpay triển khai thanh toán tiền điện	EVN hợp tác với Vnpay triển khai thanh toán tiền điện	EVN hợp tác với Vnpay triển khai thanh toán tiền điện	EVN hợp tác với Vnpay triển khai thanh toán tiền điện	EVN hợp tác với Vnpay triển khai thanh toán tiền điện	Đầu tư R&D FPT sắp thử nghiệm xe tự hành trong các khu công nghệ cao	Đầu tư R&D FPT sắp thử nghiệm xe tự hành trong các khu công nghệ cao
Dữ liệu lớn	24 pages	24 pages	24 pages	24 pages	24 pages	24 pages	24 pages	24 pages	24 pages	24 pages
	<u>Bê bối dữ liệu đầy Facebook lún sâu trong khủng hoảng</u>	<u>Bê bối dữ liệu đầy Facebook lún sâu trong khủng hoảng</u>	<u>Bê bối dữ liệu đầy Facebook lún sâu trong khủng hoảng</u>	<u>Bê bối dữ liệu đầy Facebook lún sâu trong khủng hoảng</u>	<u>Bê bối dữ liệu đầy Facebook lún sâu trong khủng hoảng</u>	<u>Bê bối dữ liệu đầy Facebook lún sâu trong khủng hoảng</u>	<u>Bê bối dữ liệu đầy Facebook lún sâu trong khủng hoảng</u>	<u>Bê bối dữ liệu đầy Facebook lún sâu trong khủng hoảng</u>	<u>Bê bối dữ liệu đầy Facebook lún sâu trong khủng hoảng</u>	<u>Bê bối dữ liệu đầy Facebook lún sâu trong khủng hoảng</u>
	Bất bình	Kỷ nguyên số và câu chuyện	Hướng dẫn kĩ thuật tiếp	Bất bình đẳng trong công	Bất bình đẳng trong công	Bất bình đẳng trong	Bất bình đẳng trong	Bất bình đẳng trong	Bất bình đẳng trong	Bất bình đẳng trong

Appendix

	đăng trong công nghệ: Khoảng cách số đang trở thành một vực thăm số	đổi mới sáng tạo của doanh nghiệp	nhận, truyền và quản lý dữ liệu	nghệ: Khoảng cách số đang trở thành một vực thăm số	nghệ: Khoảng cách số đang trở thành một vực thăm số	công nghệ: Khoảng cách số đang trở thành một vực thăm số	công nghệ: Khoảng cách số đang trở thành một vực thăm số	công nghệ: Khoảng cách số đang trở thành một vực thăm số	công nghệ: Khoảng cách số đang trở thành một vực thăm số	công nghệ: Khoảng cách số đang trở thành một vực thăm số
Cách mạng 4.0	20 pages	20 pages	20 pages	19 pages	19 pages	19 pages	19 pages	19 pages	19 pages	19 pages
	<u>Chủ tịch WEF: cách mạng 4.0 thay đổi căn bản chúng ta</u>	<u>Chủ tịch WEF: cách mạng 4.0 thay đổi căn bản chúng ta</u>	<u>Chủ tịch WEF: cách mạng 4.0 thay đổi căn bản chúng ta</u>	<u>Chủ tịch WEF: cách mạng 4.0 thay đổi căn bản chúng ta</u>	<u>Chủ tịch WEF: cách mạng 4.0 thay đổi căn bản chúng ta</u>	<u>Chủ tịch WEF: cách mạng 4.0 thay đổi căn bản chúng ta</u>	<u>Chủ tịch WEF: cách mạng 4.0 thay đổi căn bản chúng ta</u>	<u>Chủ tịch WEF: cách mạng 4.0 thay đổi căn bản chúng ta</u>	<u>Chủ tịch WEF: cách mạng 4.0 thay đổi căn bản chúng ta</u>	<u>Chủ tịch WEF: cách mạng 4.0 thay đổi căn bản chúng ta</u>
	Tôi đang đắm say người phụ nữ có chồng	Tôi đang đắm say người phụ nữ có chồng	Tôi đang đắm say người phụ nữ có chồng	Đánh giá chất lượng Ích Mẫu Lợi Nhi năm 2017	Đánh giá chất lượng Mẫu Ích Lợi Nhi	Đánh giá chất lượng Mẫu Ích Lợi Nhi	Đánh giá chất lượng Mẫu Ích Lợi Nhi	-Đánh giá chất lượng Mẫu Ích Lợi Nhi -Thanh lý oto công giá 6tr/chiếc...	- Đánh giá chất lượng.. - Thanh lý oto công..	- Đánh giá chất lượng.. - Thanh lý oto công..
AI	32 pages	32 pages	32 pages	31 pages	31 pages	31 pages	30 pages	30 pages	30 pages	30 pages
	<u>Đội quân dân nhĩn phía sau tham vọng AI củ a Trung Quốc</u>	<u>Đội quân dân nhĩn phía sau tham vọng AI củ a Trung Quốc</u>	<u>Đội quân dân nhĩn phía sau tham vọng AI củ a Trung Quốc</u>	Phát triển AI ở Đông Nam Á và cơ hội của Việt Nam	Phát triển AI ở Đông Nam Á và cơ hội của Việt Nam	Phát triển AI ở Đông Nam Á và cơ hội của Việt Nam	Phát triển AI ở Đông Nam Á và cơ hội của Việt Nam	Phát triển AI ở Đông Nam Á và cơ hội của Việt Nam	Phát triển AI ở Đông Nam Á và cơ hội của Việt Nam	Phát triển AI ở Đông Nam Á và cơ hội của Việt Nam
	Dự đoán World Cup	Dự đoán World Cup	Dự đoán World Cup	Dự đoán World Cup	Xem tử vi	Xem tử vi	Xem tử vi	Xem tử vi	Xem tử vi	Xem tử vi
Artificial	27 pages	27 pages	27 pages	27 pages	27 pages	27 pages	28 pages	27 pages	27 pages	27 pages

Appendix

Intelligence	Artificial Intelligence: The real legal issues	Artificial Intelligence: The real legal issues	Artificial Intelligence: The real legal issues	Artificial Intelligence: The real legal issues	Artificial Intelligence: The real legal issues	Artificial Intelligence: The real legal issues	Sau alpha Go, con người tiếp tục phát triển AI biết đá bóng	Artificial Intelligence: The real legal issues	Artificial Intelligence: The real legal issues	Artificial Intelligence: The real legal issues
	Vnisa trao giải sản phẩm an toàn thông tin mới xuất sắc...	Vnisa trao giải sản phẩm an toàn thông tin mới xuất sắc...	Vnisa trao giải sản phẩm an toàn thông tin mới xuất sắc...	DLSS mới là công nghệ...	DLSS mới là công nghệ...	DLSS mới là công nghệ...	Gửi 33 bài thi của học sinh VN dự ngày hội lập trình	DLSS mới là công nghệ...	DLSS mới là công nghệ...	DLSS mới là công nghệ...
Big data	24 pages	24 pages	24 pages	24 pages	24 pages	24 pages	25 pages	25 pages	25 pages	25 pages
	<u>Tiềm ẩn mặt trái của việc sử dụng Big data và AI</u>	<u>Tiềm ẩn mặt trái của việc sử dụng Big data và AI</u>	<u>Tiềm ẩn mặt trái của việc sử dụng Big data và AI</u>	<u>Tiềm ẩn mặt trái của việc sử dụng Big data và AI</u>	<u>Tiềm ẩn mặt trái của việc sử dụng Big data và AI</u>	<u>Tiềm ẩn mặt trái của việc sử dụng Big data và AI</u>	<u>Tiềm ẩn mặt trái của việc sử dụng Big data và AI</u>	<u>Tiềm ẩn mặt trái của việc sử dụng Big data và AI</u>	<u>Tiềm ẩn mặt trái của việc sử dụng Big data và AI</u>	<u>Tiềm ẩn mặt trái của việc sử dụng Big data và AI</u>
	<u>Phần mềm là tương lai của xe hơi</u>	<u>Phần mềm là tương lai của xe hơi</u>	<u>Phần mềm là tương lai của xe hơi</u>		Viettel sẵn sàng thử nghiệm 5G năm 2019	Viettel sẵn sàng thử nghiệm 5G năm 2019	Viettel sẵn sàng thử nghiệm 5G năm 2019	Viettel sẵn sàng thử nghiệm 5G năm 2019	Viettel sẵn sàng thử nghiệm 5G năm 2019	Viettel sẵn sàng thử nghiệm 5G năm 2019
Biến đổi gen	25 pages	25 pages	25 pages	25 pages	25 pages	25 pages	25 pages	25 pages	25 pages	25 pages
	<u>Những hiểu lầm về thực phẩm biến đổi gen</u>	<u>Những hiểu lầm về thực phẩm biến đổi gen</u>	<u>Những hiểu lầm về thực phẩm biến đổi gen</u>	<u>Những hiểu lầm về thực phẩm biến đổi gen</u>	<u>Những hiểu lầm về thực phẩm biến đổi gen</u>	<u>Những hiểu lầm về thực phẩm biến đổi gen</u>	<u>Những hiểu lầm về thực phẩm biến đổi gen</u>	<u>Những hiểu lầm về thực phẩm biến đổi gen</u>	<u>Những hiểu lầm về thực phẩm biến đổi gen</u>	<u>Những hiểu lầm về thực phẩm biến đổi gen</u>
	Hoảng hồn trẻ em đã bị “mỡ máu ken đặc,…”	Hoảng hồn trẻ em đã bị “mỡ máu ken đặc,…”	Hoảng hồn trẻ em đã bị “mỡ máu ken đặc,…”	Biến dạng đầu vì tự nhuộm tóc tại nhà	Biến dạng đầu vì tự nhuộm tóc tại nhà	Biến dạng đầu vì tự nhuộm tóc tại nhà	-Biến dạng đầu vì tự nhuộm tóc tại nhà	Hoảng hồn trẻ em đã bị “mỡ máu ken đặc,…”	Hoảng hồn trẻ em đã bị “mỡ máu ken đặc,…”	Hoảng hồn trẻ em đã bị “mỡ máu ken đặc,…”

Appendix

							-8 dấu hiệu mách bảo cơ thể thiếu vitamin K2				
Chuyển gen	11 pages	11 pages	11 pages	11 pages	11 pages	11 pages	10 pages	11 pages	11 pages	11 pages	
	<u>Động</u> <u>vật chuyển</u> <u>gen dùng</u> <u>cho nghiên</u> <u>cứu khoa</u> <u>học</u>	<u>Động</u> <u>vật chuyển</u> <u>gen dùng</u> <u>cho nghiên</u> <u>cứu khoa</u> <u>học</u>	<u>Động</u> <u>vật chuyển</u> <u>gen dùng</u> <u>cho nghiên</u> <u>cứu khoa</u> <u>học</u>	<u>Động</u> <u>vật chuyển</u> <u>gen dùng</u> <u>cho nghiên</u> <u>cứu khoa</u> <u>học</u>	<u>Động</u> <u>vật chuyển</u> <u>gen dùng</u> <u>cho nghiên</u> <u>cứu khoa</u> <u>học</u>	<u>Động</u> <u>vật chuyển</u> <u>gen dùng</u> <u>cho nghiên</u> <u>cứu khoa</u> <u>học</u>	<u>Động</u> <u>vật chuyển</u> <u>gen dùng</u> <u>cho nghiên</u> <u>cứu khoa</u> <u>học</u>	<u>Động</u> <u>vật chuyển</u> <u>gen dùng</u> <u>cho nghiên</u> <u>cứu khoa</u> <u>học</u>	<u>Động</u> <u>vật chuyển</u> <u>gen dùng</u> <u>cho nghiên</u> <u>cứu khoa</u> <u>học</u>	<u>Động</u> <u>vật chuyển</u> <u>gen dùng</u> <u>cho nghiên</u> <u>cứu khoa</u> <u>học</u>	<u>Động</u> <u>vật chuyển</u> <u>gen dùng</u> <u>cho nghiên</u> <u>cứu khoa</u> <u>học</u>
	Canada sẽ tiếp nhận người tị nạn bị cấm nhập cảnh vào Mỹ	Canada sẽ tiếp nhận người tị nạn bị cấm nhập cảnh vào Mỹ	Canada sẽ tiếp nhận người tị nạn bị cấm nhập cảnh vào Mỹ	Canada sẽ tiếp nhận người tị nạn bị cấm nhập cảnh vào Mỹ	Canada sẽ tiếp nhận người tị nạn bị cấm nhập cảnh vào Mỹ	Canada sẽ tiếp nhận người tị nạn bị cấm nhập cảnh vào Mỹ	Canada sẽ tiếp nhận người tị nạn bị cấm nhập cảnh vào Mỹ	Canada sẽ tiếp nhận người tị nạn bị cấm nhập cảnh vào Mỹ	Canada sẽ tiếp nhận người tị nạn bị cấm nhập cảnh vào Mỹ	Canada sẽ tiếp nhận người tị nạn bị cấm nhập cảnh vào Mỹ	Canada sẽ tiếp nhận người tị nạn bị cấm nhập cảnh vào Mỹ
GMO	26 pages	26 pages	26 pages	26 pages	26 pages	26 pages	26 pages	26 pages	26 pages	26 pages	
	<u>Thực</u> <u>phẩm biến</u> <u>đổi</u> <u>gene GMO</u> <u>có thực sự</u> <u>đáng sợ?</u>	<u>Thực phẩm</u> <u>biến đổi</u> <u>gene GMO c</u> <u>ó thực sự</u> <u>đáng sợ?</u>	<u>Thực</u> <u>phẩm biến</u> <u>đổi</u> <u>gene GMO</u> <u>có thực sự</u> <u>đáng sợ?</u>	<u>Thực phẩm</u> <u>biến đổi</u> <u>gene GMO c</u> <u>ó thực sự</u> <u>đáng sợ?</u>	<u>Thực phẩm</u> <u>biến đổi</u> <u>gene GMO c</u> <u>ó thực sự</u> <u>đáng sợ?</u>	<u>Thực phẩm</u> <u>biến đổi</u> <u>gene GMO c</u> <u>ó thực sự</u> <u>đáng sợ?</u>	<u>Thực</u> <u>phẩm biến</u> <u>đổi</u> <u>gene GMO</u> <u>có thực sự</u> <u>đáng sợ?</u>	<u>Thực</u> <u>phẩm biến</u> <u>đổi</u> <u>gene GMO</u> <u>có thực sự</u> <u>đáng sợ?</u>	<u>Thực</u> <u>phẩm biến</u> <u>đổi</u> <u>gene GMO</u> <u>có thực sự</u> <u>đáng sợ?</u>	<u>Thực</u> <u>phẩm biến</u> <u>đổi</u> <u>gene GMO</u> <u>có thực sự</u> <u>đáng sợ?</u>	<u>Thực</u> <u>phẩm biến</u> <u>đổi</u> <u>gene GMO</u> <u>có thực sự</u> <u>đáng sợ?</u>
	<u>10 loại</u> <u>thực phẩm</u> <u>càng ăn</u> <u>càng “nuôi”</u> <u>ung thư</u>	<u>10 loại thực</u> <u>phẩm càng</u> <u>ăn càng</u> <u>“nuôi” ung</u> <u>thư</u>	<u>10 loại</u> <u>thực phẩm</u> <u>càng ăn</u> <u>càng “nuôi”</u> <u>ung thư</u>	Các sự kiện khoa học năm 2018	-Các sự kiện KH -Lợn trà xanh núi Sáng..	-Các sự kiện KH 2018 -Lợn trà xanh Shurado	-Lợn trà xanh Shurado -10 loại thực phẩm càng ăn càng nuôi ung thư	-Lợn trà xanh Shurado -Làng quái thú Mobile	-Lợn trà xanh Shurado -Làng quái thú Mobile	-Lợn trà xanh Shurado -Làng quái thú Mobile	-Lợn trà xanh Shurado -Làng quái thú Mobile
Chỉnh gen	4 pages	4 pages	4 pages	4 pages	4 pages	4 pages	4 pages	4 pages	4 pages	4 pages	
	Nhà khoa học TQ tạo ra gặp song sinh chỉnh gen đầu tiên	Nhà khoa học TQ tạo ra gặp song sinh chỉnh gen đầu tiên trên thế	Nhà khoa học TQ tạo ra gặp song sinh chỉnh gen đầu tiên	Nhà khoa học TQ tạo ra gặp song sinh chỉnh gen đầu tiên trên thế	Nhà khoa học TQ tạo ra gặp song sinh chỉnh gen đầu tiên trên thế	Nhà khoa học TQ tạo ra gặp song sinh chỉnh gen đầu tiên trên thế	Nhà khoa học TQ tạo ra gặp song sinh chỉnh gen đầu tiên	Nhà khoa học TQ tạo ra gặp song sinh chỉnh gen đầu tiên	Nhà khoa học TQ tạo ra gặp song sinh chỉnh gen đầu tiên	Nhà khoa học TQ tạo ra gặp song sinh chỉnh gen đầu tiên	Nhà khoa học TQ tạo ra gặp song sinh chỉnh gen đầu tiên

Appendix

	trên thế giới	giới	trên thế giới	giới	giới	trên thế giới	trên thế giới	trên thế giới	trên thế giới	trên thế giới
	Hạt Nano thúc đẩy tế bào miễn dịch chữa trị bệnh ung thư	Hạt Nano thúc đẩy tế bào miễn dịch chữa trị bệnh ung thư	Hạt Nano thúc đẩy tế bào miễn dịch chữa trị bệnh ung thư	Hạt Nano thúc đẩy tế bào miễn dịch chữa trị bệnh ung thư	Hạt Nano thúc đẩy tế bào miễn dịch chữa trị bệnh ung thư	Hạt Nano thúc đẩy tế bào miễn dịch chữa trị bệnh ung thư	Hạt Nano thúc đẩy tế bào miễn dịch chữa trị bệnh ung thư	-Hạt Nano thúc đẩy tế bào miễn dịch chữa trị bệnh ung thư -Những dự đoán đáng sợ về ngày tận thế của trái đất	-Hạt Nano thúc đẩy tế bào miễn dịch chữa trị bệnh ung thư -Những dự đoán đáng sợ về ngày tận thế của trái đất	-Hạt Nano thúc đẩy tế bào miễn dịch chữa trị bệnh ung thư -Những dự đoán đáng sợ về ngày tận thế của trái đất

APPENDIX 3

Emails to Google

Emails to Google Press

Appendix



Minh Tran

Mon 23/09/2019 09:26

To: press@google.com



Dear Google,

My name is Minh Tran, PhD student at Bournemouth University, UK. I'm a lecturer and a researcher in media study.

I'm conducting a research into how news media representing science in Vietnam. As Vietnam doesn't have equivalent database like LexisNexis, I employed Google News for data collection. I used several key words to search for news articles about artificial intelligence, GMO and vaccine in Vietnam in the duration 01/01/2017 - 31/12/2018. However, the results differed according to **time, locations and computers** that I used to do the searching. For example, with the key word "tri tue nhan tao" (artificial intelligence), the number and order of results were different when I did the search in Vietnam, using my own laptop AND when I did the search in the UK, using my office desktop.

If it is not a business secret, I greatly appreciated Google help for classifying my questions:

1. In what way Google choose and deliver the news to audience?
2. What are specific criteria Google based on for news selection and delivery?
3. Why does the result differ in different search?

All of the information is used for my academic research. If you need any consent form for that, please let me know.

Thanks so much for your help.

Regards,

Minh.

-

Minh, Thi Yen Tran

PhD Candidate - Bournemouth University

Lecturer - Department of Journalism - Danang University - Vietnam

Recent publications:

Nguyen, A. and Tran, M., 2019. Science journalism for development in the Global South: A systematic literature review of issues and challenges. *Public Understanding of Science*

Tran, M., Nguyen, A. and Thorsen, A., 2019. The representation of Artificial Intelligence in Vietnamese news media: Attention, sources, frames and attitudes. In *Future of Journalism Conference*, Cardiff 12-13 September 2019. Cardiff, UK.

Nguyen, A. and Tran, M., 2019. Science journalism for development in the Global South: A systematic review of its characteristics, issues and challenges. In: *Top Papers in Global Communication and Social Change, 69th Annual Conference of the International Communication Association* 24-28 May 2019 Washington, DC.

Tran, M., Nguyen, A. 2019. Professional challenges and impediments to science journalism in Vietnam. In *IAMCR Conference July 2019 Madrid, Spain*.

Tran, M. 2019. The representation of scientific controversies in Vietnamese online newspapers. In *Popular Culture Association Conference April 2019 Washington, DC*.

Emails to representative of Google News Lab

Appendix

[redacted]@google.com>

Mon 30/09/2019 17:12

To: Minh Tran

Hi Minh,

Unfortunately due to the sensitivities around revealing the operations of the algorithm the best I can do is direct you towards press@google.com

Apologies that I can't be of more assistance on this matter.

Vincent.

On Mon, Sep 23, 2019 at 4:10 AM Minh Tran <mtran@bournemouth.ac.uk> wrote:

Dear [redacted]

My name is Minh Tran, PhD student at Bournemouth University.

I attended your presentation at [redacted] and when looking for information for my research, I found that you may know something that help me a lot. I hope that this email would not trouble you.

I'm conducting a research into how news media representing science in Vietnam. As Vietnam doesn't have equivalent database like LexisNexis, I employed **Google News** for data collection. I used several key words to search for news articles about artificial intelligence, GMO and vaccine in Vietnam in the duration 01/01/2017 - 31/12/2018. However, the results differed according to **time, locations and computers** that I used to do the searching. For example, with the key word "tri tue nhan tao" (artificial intelligence), the number and order of results were different when I did the search in Vietnam, using my own laptop AND when I did the search in the UK, using my office desktop. Even I read the Google mission <https://newsinitiative.withgoogle.com/hownewsworks/mission/>, I was not very clear about how Google offer news to audience.

If it is not a business secret, I greatly appreciated your help for classifying my questions:

1. In what way Google choose and deliver the news to audience?
2. What are specific criteria Google based on for news selection and delivery?
3. Why does the result differ in different search?

If you cannot give me an answer but know someone in your department can, may you help me direct to him/her?

All of the information is used for my academic research. If you need any consent form for that, please let me know.

Thanks so much for your help.

Regards,


Minh.

--

Minh, Thi Yen Tran
PhD Candidate - Bournemouth University
Lecturer - Department of Journalism - Danang University - Vietnam
Recent publications:

Appendix

Google News Information +

 Minh Tran
Tue 08/10/2019 15:40
To: [redacted]@google.com>
Hi [redacted]
Anyway, thanks so much for your kindness.
All the best,
Minh.


--
Minh, Thi Yen Tran
PhD Candidate, Bournemouth University
++44 7518764533
...

[Reply](#) | [Forward](#)

[redacted] google.com>
Thu 03/10/2019 19:49
To: Minh Tran
Hi Minh,

Unfortunately I do not work directly on the algorithm and have no visibility on how it operates globally. I'm sorry that I can't be of more help.
[redacted]
...

[redacted] newslabsupport@google.com

 Minh Tran
Wed 02/10/2019 20:37
To: [redacted]@google.com>
Dear [redacted]
Thank you very much for your assistance. I had contacted Google Press but haven't got any response yet.
I know that you're very busy at work, but, may I ask you one more question if possible?

Is the the operations of the algorithm in Google News English and Google News Vietnamese similar or different?

I hope that you know something that may help my project.
Thank you in advance.
Regards,
Minh.

--
Minh, Thi Yen Tran
PhD Candidate - Bournemouth University
Lecturer - Department of Journalism - Danang University - Vietnam
...

APPENDIX 4

Interview Protocol

Vietnamese version

A. Tác nghiệp báo chí khoa học

1. Anh/ chị phụ trách những mảng nào? Anh/ chị có được đào tạo và tự đào tạo về mảng mình theo dõi?
2. Ở đơn vị của anh/ chị có dành riêng vị trí cho các vấn đề khoa học? Vị trí của khoa học so với các mảng khác như thế nào?
3. Anh chị quan niệm như thế nào về báo chí khoa học, vai trò và chức năng của nó đối với sự phát triển?
4. Các vấn đề khoa học mà anh chị thường xuyên theo dõi là gì? Vì sao các mảng đó lại được quan tâm?
5. Anh/ chị có thể chia sẻ về quy trình khai thác và sản xuất tin-bài khoa học?
6. Anh/ chị có thể chia sẻ những tiêu chí nào ảnh hưởng đến việc lựa chọn và cách thức tường thuật thông tin khoa học?
 - + Quy trình tác nghiệp diễn ra như thế nào?
 - + Nguyên tắc lựa chọn thông tin khoa học là gì?
 - + Nguồn tin của các anh chị đến từ đâu? Các anh chị có kiểm tra/ phối kiểm nguồn tin từ các nhà khoa học không?
 - + Anh chị thường thể hiện thông tin khoa học dưới dạng thức nào? Tin hay bài? Anh/ chị có thực hiện các bài điều tra/ phân tích/ bình luận dài kỳ về khoa học không?
7. Anh/ chị có chịu áp lực gì từ đơn vị quản lý (ban biên tập) trong quá trình tường thuật khoa học không?
8. Anh/ chị có thể mô tả và đánh giá mối quan hệ giữa anh chị với giới khoa học, các nhóm NGOs, các nhóm lợi ích kinh tế, nhà quản lý chính sách trong quá trình thực hiện tin - bài khoa học. Anh/ chị có chịu áp lực hay trở ngại gì từ các nhóm đó không?
9. Những khó khăn khác của các anh chị trong quá trình tác nghiệp?

10. Các anh chị có cần thêm sự hỗ trợ gì để nâng cao năng lực tác nghiệp?

11. Cuối cùng, anh/ chị có thể đánh giá mức độ chuyên nghiệp của báo chí khoa học ở Việt Nam?

B. Các vấn đề khoa học gây tranh cãi

1. Anh/ chị nhìn nhận như thế nào về tranh cãi khoa học?

2. Anh/ chị nhìn nhận như thế nào về trách nhiệm của một nhà báo khoa học trong việc tường thuật các vấn đề khoa học gây tranh cãi?

3. Một số vấn đề như biến đổi gen, công nghệ tế bào gốc, vaccine, trí tuệ nhân tạo được báo chí Việt Nam và cá nhân anh/ chị quan tâm như thế nào?

4. Theo cách nhìn của anh/ chị, các nhà báo Việt Nam đã làm tốt vai trò của mình trong việc tường thuật thông tin khoa học gây tranh cãi hay chưa?

C. Tường thuật Covid-19

1. Anh/ chị xác định vai trò, nhiệm vụ của mình như thế nào khi tường thuật Covid-19?

2. Anh/ chị chị trang bị cho mình những kiến thức và kỹ năng như thế nào để khai thác một đề tài mới và còn nhiều tranh cãi?

3. Anh/ chị có thể cho biết những yếu tố nào chi phối anh/ chị trong việc lựa chọn đề tài và tường thuật thông tin về Covid-19?

4. Toà soạn định hướng cho anh chị trong quá trình tác nghiệp như thế nào?

5. Các bên liên quan, ví dụ: các bác sĩ, chính phủ, các nhóm nghiên cứu và công ty vaccine có tác động như thế nào đến quá trình tác nghiệp của anh/ chị?

6. Những khó khăn anh chị gặp phải trong quá trình tác nghiệp? Đối với mỗi khó khăn, anh/ chị đã khắc phục như thế nào?

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7. Anh/ chị có thể đánh giá vai trò và tầm quan trọng của thông tin Covid so với những thông tin khác? Cùng và trước đó, anh chị dành mỗi quan tâm như thế nào cho các vấn đề về khoa học - sức khỏe?

****Chú ý cho ví dụ minh họa để làm rõ câu trả lời.***

English version

A. Reporting science

1. Which news beat are you in charge of? Have you been trained and self-trained in the specialist section you are responsible for?
2. Is there a specialist section and dedicated team for science in your newsroom? Could you compare its position to other areas?
3. Please explain your understanding of science journalism; What do you think about the role and function of science journalism for development?
4. What are the most prominent science issues that you are reporting? Why?
5. Please describe your news reporting process.
6. What criteria influence your news selection and construction?
7. What pressures are you facing in your newsroom?

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8. Would you describe the relationship between science reporters and other vested groups? How do you evaluate the support of scientific community for science reporting? How do you think about the impact of vested groups, such as NGOs, policy maker or S&T corporations on science reporting?
9. What are difficulties challenging your science reporting?
10. What are possible supports needed to improve your reporting?
11. Finally, could you evaluate the professionalism of science journalism in Vietnam?

B. Reporting scientific controversies

1. How do you think about scientific controversies?
2. How do you think about the role of science journalism in reporting scientific controversies?
3. To which extent Vietnamese news media, particularly you, give attention to scientific controversies, such as GMO, vaccination, AI, stem cell?
4. Could you assess the professionalism of science journalism in reporting scientific controversies?

C. Reporting Covid-19 pandemic

1. How do you define your role and mission in reporting Covid-19 pandemic?
2. How did you prepared to deal with Covid-19 while it is very new and controversial?
3. What are factors influencing your selection and framing of Covid-19?
4. How does your newsroom direct your reporting?
5. How do other stakeholders, i.e. scientists, the state, vaccine research groups and companies, affect your reporting?
6. Are there any obstacles constraining your Covid-19 reporting? How do you overcome?

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7. Could you assess the importance of Covid-19 pandemic reportage, especially compared to other S&T issues? Before Covid-19 pandemic, and at the same time of the disaster, to which extent you pay attention to S&T event/ issue?

****Give examples for your answers.***

APPENDIX 5

Coding book

GENERAL CODING NOTE

The unit of analysis is the individual news article.

In most of the categories, coders can only choose one option. The sub-code is used to provide further specificity.

Coders need to read the coding guideline carefully before making decisions.

A. NEWS ARTICLE META-DATA

Each document should contain the following meta-data attributes. Coders can only choose one option or fill in a specific number which suits the guidelines.

Q1. Publication: Name of the news sites (publications)

Code = Write down the name of the news sites. e.g. Thanh Nien, Tuoi tre, dantri.vn...

Q2. Date of publication:

Code = Fill in the date, e.g. 01/01/2018

Q3. Length: Number of words the article contains

Code = Fill in a unique number of sample.

Range from 1 to 9999

B. FORMAL CHARACTERISTICS OF NEWS ARTICLES

Q4. Authorship: Role of the author(s)

Code = select *one* of the following codes

1	Reporter	Reporter, including general and specialist reporter, full time or freelancer contributor who sign under the news articles by his proper name or pen-name. Even the article was signed under a specific name, if it was entirely duplicated/ translated from other sources, it is not coded as “reporter”.	http://soha.vn/tri-tue-nhan-tao-va-bao-chi-ngoi-cho-tuong-lai-hay-hanh-dong-ngay-20181228212644276.htm
2	Expert	The person who is specialist in science or is very knowledgeable about a particular area which is related to science. They are: scientist, technical expert, university professor, doctor, health advisor, ...They usually signed their names along with the title “expert” or identify their positions at the scientific institutions.	http://tiasang.com.vn/-dien-dan/Chinh-phu-mo-Trien-vong-va-tac-dong-den-quan-tri-nha-nuoc-o-Viet-Nam-14080
3	Politician	The person who is professionally involved in politics, policy making and enforcement. They usually signed their names along with their titles at the governmental institutions.	
4	International news wire service or news sites	Signed under the name of an international news-site or referenced to other foreign newspapers, radios, television channels, news websites, e.g. BBC, CNN, The Guardian, AP, Reuter, APF, Xinhua.	https://dantri.com.vn/khoa-hoc-cong-nghe/cay-bien-doi-gen-co-the-lam-sach-khong-khi-o-nhiem-20181225092311587.htm
5	National or local news wire service, newspapers and news outlets	Signed under the name of a Vietnamese news-site or referenced to other Vietnamese newspapers, radios, television channels, news websites, e.g. Vietnamnet, Vietnam Television Chanel, Vietnam Agency...	http://cafef.vn/cay-trong-bien-doi-gen-mang-lai-loi-ich-lau-dai-cho-nong-nghiep-viet-2018070711205398.chn

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6	No byline	Unsigned author	https://vn.sputniknews.com/opinion/201801314730057
7	Others or Unclear	Other or unspecified authorship, inc. co-authors that cannot certify their roles or signed by the editorial board or abbreviation	https://dantri.com.vn/suc-manh-so/cong-nghe-bigdata-va-tri-tue-nhan-tao-dang-dua-nganh-bao-hiem-vao-thoi-dai-moi-20190110153736087.htm

Q5. Genre: *What genre the article was reported*

Code = select *one* of the following codes

What genre the article was reported

1	Straight news	Focus in basic W-questions: the what, who, when, where, why, whom of the event	https://tuoitre.vn/hoc-sinh-sinh-vien-thi-y-tuong-te-bao-goc-20171205131719011.htm
2	Feature	A news story that deals in depth with a particular topic, usually come later in the event cycle	https://tuoitre.vn/lan-kim-tiem-te-bao-goc-coi-chung-nat-mat-lan-kim-tiem-te-bao-goc-coi-chung-nat-mat-20170908165353261.htm
3	Opinion	An article in which the writer expresses their personal viewpoint, subjective opinion, typically one which is controversial or provocative, about a particular issue or item of news. It can be written by the editor(s) (editorials) or independent writer (columns). It also includes letters to the editor.	https://vnexpress.net/tin-tuc/goc-nhin/cach-mang-4-0-3578281.html https://tuoitre.vn/nha-giao-day-gi-khi-da-co-nhung-ong-thay-internet-20171119081551021.htm http://khoahocphattrien.vn/cong-nghe/hieu-ro-hon-ve-cach-mang-cong-nghiep-40-nho-khoa-hoc-va-phat-trien/20170818093942301p1c859.htm
4	Interview	Formed by Q&A format	http://soha.vn/toan-bo-cuoc-phong-van-nu-robot-sophia-toi-cung-thay-son-gai-oc-20171028201543128.htm
5	Video	Only when the page is solely devoted to one or more videos. If an article has more than three	https://www.tienphong.vn/video-clip/trung-quoc-dieu-tra-khan-thi-nghiem-2-em-be-bien-doi-gen-

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		paragraphs of explanation, and / or cites multiple sources in the text it is NOT a video.	1350622.tpo
6	Gallery	When the page is solely devoted to one or more images, including graphic news	https://www.vietnamplus.vn/chiem-nguong-canhdong-ngo-bien-doi-gene-dep-nhu-tranh-o-thainguyen/542941.vnp https://www.vietnamplus.vn/infographics-10-dot-phong-ten-lua-du-kien-tien-hanh-trong-nam-2019/547083.vnp
7	Long-form/ mega/multi-media story	Longer articles with larger amounts of content (more than 2000 words) and multi-media storytelling technique, combination of text, still photographs, video clips, audio, infographics, timeline and interactivity	http://special.vietnamplus.vn/tri_tue_nhan_tao_va_bao_chi http://special.vietnamplus.vn/AI_journalism
8	Others	Any other genres that cannot be classified in above	

Q6. Headlines

Q6.1. Types of headline (What format the headline was structured) ⁴¹

Code = select *one* of the following codes

1	Label headline	Focusing on the object of story. Verb is missed and usually used in brief news and limited space	
2	Descriptive headline	Capturing the story essence, generating reader interest	<i>Lần đầu tiên Việt Nam ghép tế bào gốc lấy từ người ở nước ngoài</i> https://thanhnien.vn/suc-khoe/lan-dau-tien-viet-nam-ghep-te-bao-goc-lay-tu-nguoi-cho-o-nuoc-ngoai-900679.html

⁴¹ Adopt from Saxena Sunil. 2006. *Headline Writing*. Sage: New Deli.

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3	Running up headline	Focusing on the latest development of story	<i>Tin thêm vụ bé sơ sinh tử vong sau khi tiêm phòng vaccine viêm gan</i> http://vov.vn/xa-hoi/tin-them-vu-be-so-sinh-tu-vong-sau-tiem-phong-vaccine-viem-gan-b-687390.vov <i>Cháu bé tử vong sau tiêm vaccine: Loại trừ nguyên nhân do vaccine</i> https://vov.vn/tin-24h/chau-be-tu-vong-sau-tiem-vaccine-loai-tru-nguyen-nhan-do-vaccine-606384.vov
4	Commentary headline	Adding extra meaning to the headline	<i>Năm 2017 không êm ả với các ông lớn công nghệ Mỹ</i> https://thanhnien.vn/kinh-doanh/nam-2017-khong-em-a-voi-cac-ong-lon-cong-nghe-my-918692.html
5	Testimonial headline	Direct or indirect quotation, statement from a person	<i>“Vinmec có thể làm tốt công tác khám điều trị ung thư”</i> https://khoa360.tienphong.vn/gia-dinh-suc-khoe/vinmec-co-the-lam-tot-cong-tac-kham-dieu-tri-ung-thu-1125087.tpo
6	Question headline	Forming headline by asking a question	<i>Tại sao phải tạm dừng ghép tế bào gốc trị ung thư vú?</i> http://soha.vn/xa-hoi/tai-sao-phai-tam-dung-ghep-te-bao-goc-tri-ung-thu-vu-20150619105507658.htm
7	Number headline	Important or impressive number is used in the headline	<i>Trí tuệ nhân tạo phát hiện 85% khả năng tấn công mạng, ngày thông minh hơn</i> https://congnghe.tuoiitre.vn/nhip-song-so/tri-tue-nhan-tao-phat-hien-85-kha-nang-tan-cong-mang-ngay-cang-thong-minh-hon-1086892.htm
8	Others or Unclear		

Q6.2. Tone of headline

Code = select *one* of the following codes

Coders identify tone of headlines based on whether the headline mentions science potential consequences? Headline with a dominant discourse of promising portrays science controversy in a favourable light, typically included strongly favourable adjectives or adverb. On the other hand, headline with a dominant discourse of concerning portrays science controversy in an opposing light,

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typically included strongly critical adjectives or adverb. However, sometimes, the discourses containing words related to positive/negative could be used to express an opposite meaning.

For example, even the headline “*Đột phá mới từ trí tuệ nhân tạo – Vượt khỏi tầm kiểm soát của con người*” [New AI breakthrough – Over human control] contains the word “breakthrough” but the whole sentence refers to negative outcome.

Thus, coders need to read and consider carefully not only a single word but also the words used in the headline are those reflecting the science promising or threatening consequence.

Code = 1 = Negative

Code = 2 = Balance

Code = 3 = Positive

1	Negative	Expressing the threatening consequence. Title may contain alarmed words, such as: Nguy cơ (risk), Huỷ diệt (destroy), Thảm hoạ (disaster), Báo động (alarm), Hoảng sợ (panic) or verbs frightening human safety	<i>Nguy cơ trí tuệ nhân tạo thao túng con người</i> https://vnexpress.net/tin-tuc/khoa-hoc/nguy-co-tri-tue-nhan-tao-thao-tung-con-nguoi-3668956.html?utm_source=search_vne <i>Viễn cảnh huỷ diệt khi AI thống trị</i> https://sohoa.vnexpress.net/tin-tuc/doi-song-so/vien-can-huy-diet-khi-ai-thong-tri-3669606.html?utm_source=search_vne
2	Balance/ promising and threatening	Both and Mentioning both promising and concerning consequence.	<i>Thực phẩm biến đổi gen: Lợi thì có lợi nhưng còn ẩn khoản</i> https://thethaovanhoa.vn/xa-hoi/thuc-pham-bien-doi-gen-loi-thi-co-loi-nhung-con-ban-khoan-n20161003113957767.htm <i>Thực phẩm biến đổi gen, “hạt giống diệu kì” hay “chất độc màu xanh”</i> https://dantri.com.vn/khoa-hoc-cong-nghe/thuc-pham-bien-doi-gen-hat-giong-dieu-ky-hay-chat-doc-mau-xanh-2017082620541975.htm
3	Positive	Expressing the promising science consequence. Title may contain promising words, such as: Lần đầu tiên (The first time), Đặc biệt (Special), Kì diệu (Miracle,	<i>Ứng dụng trí tuệ nhân tạo giúp tăng doanh số bán hàng</i> https://startup.vnexpress.net/tin-tuc/y-tuong-moi/ung-dung-tri-tue-nhan-tao-tang-doanh-so-ban-hang-3614924.html?utm_source=search_vne <i>Bác sĩ sống thực vật hồi sinh kì diệu nhờ ghép tế bào gốc</i>

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	Wonder), Ngoạn mục (Spectacular), Đột phá (Breakthrough), Hữu ích (Helpful), Cuộc cách mạng (Revolution)	https://suckhoe.vnexpress.net/tin-tuc/suc-khoe/bac-si-song-thuc-vat-hoi-sinh-ky-dieu-nho-ghep-te-bao-goc-3575026.html?utm_source=search_vne
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Q7. Lead format (How the lead was formed)

Q7.1. Types of lead

Code = select *one* of the following codes

1	Summary/ Descriptive	Formed by grammatical form of simple sentences to tell audience who perform what the action for whom and where, when the action occurs as well as a brief indication of why and how the action happens	<i>Tại triển lãm CES 2018 (Mỹ), nhà sản xuất chip Intel công bố hợp tác với Ferrari Bắc Mỹ để triển khai hệ thống máy bay không người lái (drone) hỗ trợ phân tích cuộc đua xe dựa trên trí tuệ nhân tạo (AI)</i> https://thanhnien.vn/cong-nghe/intel-phoi-hop-ferrari-dua-tri-tue-nhan-tao-vao-dua-xe-922447.html
2	Anecdotal	Formed by an interesting story, life experience or event that closely illustrates the article's broader point	<i>Nhìn bé Nguyễn Võ Hoàng Thiên (14 tháng tuổi, ở TP Vũng Tàu) nhanh chóng ăn hết bát cháo đầy, chơi đùa vui vẻ cùng em trai song sinh Hoàng Phúc - ít ai nghĩ rằng chỉ 8 tháng trước, sự sống của bé rất mong manh</i> http://soha.vn/ghep-te-bao-goc-cuu-song-ngoan-muc-be-trai-sinh-non-bi-xo-phoi-20171227164504005.htm
3	Metaphor	Formed by an (explicit) comparison between a person or object with something that is considered to have similar characteristics to that person or object	<i>“Chỉnh sửa gen người: Mọi con đường dẫn đến địa ngục đều được lát bằng những thiện ý”</i> http://soha.vn/chinh-sua-gen-nguoi-moi-con-duong-dan-den-dia-nguc-deu-duoc-lat-bang-nhung-thien-y-20181213092145104.htm <i>“Trí tuệ nhân tạo “tấn công” hội họa”</i>

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			https://thanhvien.vn/van-hoa/tri-tue-nhan-tao-tan-cong-hoi-hoa-1021592.html
4	Citation, reference authority to	Formed by a brief quotation, supported by additional narration	<p>“Người Việt Nam đâu phải kém, giới khoa học nghiên cứu rất giỏi, học sinh đi thi đều đạt giải cao... quy định nào khiến chúng ta chậm phát triển như vậy. Đó chính là <u>thể chế chính sách</u>, những vấn đề này cần phải tháo gỡ”</p> <p>https://thanhvien.vn/thoi-su/thu-tuong-chi-diem-3-dot-pha-cua-khoa-hoccong-nghe-922092.html</p>
4	Others	Other types of lead	

Q7.2. Tone of lead

Code = select *one* of the following codes

Coders identify tone of lead based on whether the lead mentions science potential consequences? Lead with a dominant discourse of promise portray science controversy in a favourable light, typically included strongly favourable adjectives or adverb. On the other hand, lead with a dominant discourse of concern portray science controversy in an opposing light, typically included strongly critical adjectives or adverb. However, sometimes the discourses containing words related to positive/ negative could be used to express the opposite meaning.

For example, the lead below portrays AI with the positive words “more popular”, “more intelligent” but the whole paragraph reflects a warning message about the damage of AI to human being.

Theo một nghiên cứu đăng tải trên tạp chí JAMA Network Open số ra mới đây, tính bảo mật dữ liệu y tế cá nhân đang đối mặt với nhiều mối đe dọa khi ứng dụng AI ngày càng phổ biến và trở nên thông minh hơn

[According to a recent study published in the latest issue of JAMA Network Open, personal health data security is facing many threats as AI applications become more popular and smarter]

Thus, coders need to read and consider carefully not only a single word but also the words, and sentences used in the lead are those reflecting the science promising or threatening consequence.

Code = 1 = Negative

Code = 2 = Balance

Appendix

Code = 3 = Positive

1	Negative	Expressing the threatening consequence. Title contains alarmed words, such as: Nguy cơ (risk), Huỷ diệt (destroy), Thảm hoạ (disaster), Báo động (alarm), Hoảng sợ (panic) or verbs frightening human safety	<i>Mã độc sử dụng trí tuệ nhân tạo (AI) rất có thể sẽ là mối đe dọa nguy hiểm nhất cho doanh nghiệp, cá nhân trong năm 2019</i> https://baodautu.vn/ma-doc-su-dung-tri-tue-nhan-tao-de-doa-doanh-nghiep-d93998.html
2	Balance/ Both promising and threatening	Mentioning both promising and concerning consequence.	<i>Thời tiết cực đoan đang đe dọa an ninh lương thực toàn cầu. Các nhà khoa học chỉnh sửa gen cây trồng cho rằng họ đã tìm ra câu trả lời. Tuy nhiên, các nhà môi trường lại tỏ ra thận trọng.</i> https://vietnambiz.vn/cong-nghe-chinh-sua-gen-loi-giai-cho-bai-toan-an-ninh-luong-thuc-toan-cau-55609.html
3	Positive	Expressing the promising science consequence. Title contains promising words, such as: Lần đầu tiên (The first time), Đặc biệt (Special), Kì diệu (Miracle, Wonder), Ngoạn mục (Spectacular), Đột phá (Breakthrough), Hữu ích (Helpful), Cuộc cách mạng (Revolution)	<i>Tốc độ phát triển trí tuệ nhân tạo (AI) ở mức đáng kinh ngạc. Chỉ trong lĩnh vực tạo dựng hình ảnh, AI đã có những thành tựu bất ngờ.</i> https://vov.vn/cong-nghe/tri-tue-nhan-tao-dat-thanh-tuu-bat-ngo-trong-tao-dung-hinh-anh-853509.vov

Q8. Section (the beat the news article appeared in)

Appendix

Code = select *one* of the following codes

Different newspapers have different news beats; thus, the coders read the whole article and label the article (1) by the section name if it is positioned in the section of which name coincides with one of the variables below; (2) by the section name which is mostly related to its content and journalistic viewpoint if the news beat is different to the variable system.

1	National	Section primary covers stories on national level, including the state, politic and legislation
2	International	Section primary covers stories on international level, including foreign news, politic and legislation
3	Economic, Finance and Business	Section primary covers stories in trading, business and finance
4	Science and Technology	Section primary covers scientific and technological issues, inc. environment, health and medical science
5	Society and Lifestyle	Section primary covers daily activities and social events
6	Education	Section primary covers activities, policies and events in education
7	Sport	Section primary covers athletic activities, including physical competition and gaming
8	Art and Entertainment	Section primary covers art and entertaining activities
9	Others	

Q9. Supplementary materials

Code = select **multi supplementary** materials which were used in the article of the following codes

1. None
2. Picture/ Image: A picture is a visual presentation of someone or something e.g. painting, drawing. An image is a picture that has been created or copied and stored in electronic form
3. Cartoon or caricature: A simple drawing showing the features of its subjects in a humorously exaggerated way
4. Slide shows: A presentation supplemented by or based on a display of projected images or photographic slides
5. Table (word or numbers): a set of facts or figures systematically displayed, especially in columns

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6. Diagram/ schema/map: A simplified drawing showing the appearance, structure, or workings of something; a schematic representation.
7. Animation: Animation consists of still images displayed so quickly that they give the impression of continuous movement
8. Video: Video is defined as the display of recorded real events on a television type screen. Videos usually have audio components that correspond with the pictures being shown on the screen
9. Audio: Audio is a record of captured sound, including the music, speech, interview or noises...
10. Hypertext: A hypertext system consists of nodes. It contains the text and links between the nodes, which define the paths the user can follow to access the text in non-sequential ways. The links represent associations of meaning and can be thought of as cross-references
11. Others

Q10. Comments of readers (whether the readers comment on news article ?)

Code = Fill the numbers of comments

C. THE NEWS ARTICLE NARRATIVES

Q11. Topic (What primary type of science controversy was covered)

Code = select *one* of the following codes

Topic is the main subject of a text, discourse, or conversation. News article topic is a discussed issue or event that provides message content.

Coders scan the whole content and select only one topic which is primarily covered in the article. When in doubt, coders can select one topic comprising of the most characters and judgement should be made by following criteria:

- *The prominence given to the topic*
- *The frequency of the topic occupies in the article*
- *The topic was mentioned in the headlines and/or lead of the article*

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Q11a. GMO sub-topic: What is the main focus of GMO article?

Code = select *one* of the following codes

1	Plant	Sub-topic includes: GMO seed, GMO plant, GMO crop	https://tuoitre.vn/scotland-cam-hoan-toan-viec-trong-nong-san-bien-doi-gene-947373.htm
2	Food	Sub-topic includes: GMO salmon, GM soya bean, GM maize, GM fruits, golden rice and food use animal	https://tuoitre.vn/thuc-pham-bien-doi-gen-phai-ghi-tren-nhan-mac-1022809.htm
3	Animal	Sub-topic refers to genetic modification of animals, such as: bio-pharm, companion animal, research animal. Food use animal is coded for food (2)	https://tuoitre.vn/muoi-bien-doi-gen-chong-benh-sot-ret-1008637.htm
4	Human health	Sub-topic refers to genetic modification for health and medical treatment	https://tuoitre.vn/my-lan-dau-cap-phep-ung-dung-cong-nghe-bien-doi-gen-tri-ung-thu-my-lan-dau-cap-phep-ung-dung-cong-nghe-bien-doi-gen-tri-ung-thu-20170906141615909.htm
3	Others or Unclear	Code as other if the topic does not fit under any of the above	https://tuoitre.vn/virut-cum-gia-cam-da-co-bien-doi-gen-475848.htm

Q11b. ARTIFICIAL INTELIGENCE sub-topic

What is the sub-topic (secondary topic) of AI about?

Code = select *one* of the following codes

1	Education	Sub-topic mentions training course or educational program about AI and AI applications in education, such as: learning machine, distance learning.	https://tuoitre.vn/dua-tri-tue-nhan-tao-vao-dai-hoc-hiu-2017102110583503.htm https://congnghe.tuoitre.vn/tri-tue-nhan-tao-se-thay-doi-nganh-giao-duc-ra-sao-20170808193216107.htm
2	Economic and financial	Sub-topic includes: search engine, statistical software, targeted online advertisement, banking software	https://laodong.vn/thi-truong/khoi-nghiep-ung-dung-cong-nghe-tri-tue-nhan-tao-606655.blđ https://congnghe.tuoitre.vn/nhip-song-so/4-cach-tri-tue-

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			nhan-tao-thay-doi-nganh-cong-nghiep-dich-vu-thuc-dia-20170728201216156.htm
3	Human resources in industry and service	Sub-topic refers to automatic online assistants, robot, translation software, industrial machinery system	https://congnghe.tuoitre.vn/trung-quoc-lap-don-can-h-sat-khong-nguoi-hoat-dong-bang-tri-tue-nhan-tao-20171110112427204.htm http://khoahocdoisong.vn/ha-noi-dung-tri-tue-nhan-tao-de-cham-soc-khach-hang/
4	Hospital and medical treatment	Sub-topic mentions AI machine to assist doctors in disease examination and surgery, such as: robot in cancer surgery, computer software in scan reading	https://thanhvien.vn/suc-khoe/ung-dung-tri-tue-nhan-tao-trong-dieu-tri-ung-thu-908980.html
5	Gaming and entertainment	Sub-topic includes AI gaming software, such as: chess, poker or AI performance in drawing, making poems or writing novels	https://laodong.vn/video-cong-nghe/cong-nghe-360-tri-tue-nhan-tao-alphago-chien-thang-ky-thu-co-vay-so-1-the-gioi-nguoi-trung-quoc-667475.bld
6	Transportation	Sub-topic includes self-driving vehicles such as Tesla, Google, Apple car and drones.	https://congnghe.tuoitre.vn/nhip-song-so/waymo-thu-nghiem-xe-tai-khong-nguoi-lai-20170706120544667.htm
7	Others or unclear	Code as other if the topic does not fit under any of the above	https://tuoitre.vn/elon-musk-phai-kiem-soat-tri-tue-nhan-tao-truoc-khi-qua-muon-1353016.htm

Q12. Theme of story (What primary themes of scientific controversy were covered)?

Code = select *one* of the following codes

A theme is a cluster of message properties of a topic. It is the central idea implied in the text that the writers want to convey. Coder chooses the main idea in the article, the most salient theme mentioned in the headline and/or lead.

1	New scientific research	This includes issues such as new invention, discovery, innovation,	https://thanhvien.vn/doi-song/khoa-hoc/lon-bien-doi-gien-chap-nhan-moi-te-bao-ghep-1325.html

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		achievement	
2	Scientific or technical research process	This includes ongoing scientific project, such as research in lab, scientific testing.	https://thanhvien.vn/suc-khoe/lam-tre-hoa-te-bao-mau-goc-de-chua-benh-804539.html
3	Science and technological applications and implications	This includes issues of what and how science and technology impacts on human life, including risks and benefits, such as: health and medical treatment, AI machine, the productivity of GM crops, the risk of GM foods, the benefit of vaccination and risk of HPV vaccine.	https://thanhvien.vn/suc-khoe/than-trong-khi-tiem-te-bao-goc-22123.html https://thanhvien.vn/suc-khoe/gia-tri-cua-vaccine-trong-viec-phong-benh-cho-ca-nha-733130.html http://soha.vn/tri-tue-nhan-tao-se-giup-ban-tien-de-ra-tien-20160916124451942.htm
4	Scientific and technological policy and legislation	This includes issues referring to how scientific controversy was presented, discussed and made by law, policy and regulation.	https://thanhvien.vn/the-gioi/ngoi-tu-vi-khong-cho-con-chich-ngua-882709.html
5	Scientific and technological trading and industry	This includes issues such as industrial plan, (GMO or stem cell) market, vaccination service, (AI) company, job, economy, income, labour force, taxes and or financial problems, funding.	https://thanhvien.vn/suc-khoe/mo-website-dang-ky-tiem-vac-xin-651897.html
6	Scientific and technological debate	This concentrates on the disagreements, conflicts between different stakeholders about the risks and benefits of S&T	http://soha.vn/ong-chu-hang-tesla-canh-bao-ve-chien-tranh-the-gioi-thu-ba-2017090609111145.htm https://tuoitre.vn/gmo-va-cuoc-tranh-luan-chua-ket-thuc-750636.htm
7	Public perception on science and technology	This focuses on the lay people understanding and engagement in science and technology, such as public movement, competition and education.	https://tuoitre.vn/dua-tri-tue-nhan-tao-vao-dai-hoc-hiu-2017102110583503.htm
8	Others or Unclear	Code as other if the topic does not fit under any of the above	

Q13. Frame of story

Code = select *one* of the following codes.

Adopted from Bauer et al. (1995), Durant et al. (1998), Nisbet and Lewenstein (2002)

A lens through which a message may be presented to the audience. This lens may affect the perceptions that the audience forms about a topic. Coders can choose only one answer.

1	Progress	The starting-point is the celebration of scientific progress, new development and the breakthrough, “war of the future”
2	Economic prospect	Economic side of science and especially its applications, including business opportunities and financial possibilities and/or consequences
3	Ethical	Science regarded from an ethical viewpoint, weighing up the pros and cons, making value judgments
4	Pandora’s Box	A specific scientific application is regarded as a potentially serious threat if it is deployed initially or continually without the consequences being clear, it being advisable in such cases not to carry on or proceed in the first place
5	Run away	An existing application is deemed damaging and the consequences and already irreversible, the argument being that the technology should be dropped so as to avoid worse consequences and engage in a damage limitation exercise
6	Nature/ Nature	Debate about the hereditary and genetic component in organisms, more specifically the question of what is pre-determined by hereditary factors at the time of conception and what is conditioned by environmental factors
7	Public accountability	Demand for transparency with respect to procedures, regulations, and more public involvement and participation
8	Globalisation	Call for a global outlook on scientific controversies, competitiveness within a global economy
9	Localisation	Call for a local outlook on scientific controversies, linking the global issues into local context
10	Long-way away ⁴²	Applications from science will be in the distant future
11	Others	

⁴² Framing risk: nanotechnologies in the news (Stuart Allan, Alison Anderson and Alan Petersen)

Q14. Type of coverage: (storytelling) *prominent framework forming the story*

Code = select *one* of the following codes

1	Event-based story	Episodic – current moment focus, single case study, person-central, a snapshot of “what”, “when”, “where” happened
2	Issue-based story	Thematic –contextual, process, analytical focus, general topic, emphasizing the questions “why” and “how”

Q15. Controversy:

What type of controversy was focused?

Code = select *one* of the following codes

An article may concern on one matter or cover several issues. If there are more than one controversy, coders choose the most prominent scientific controversy was covered in the article

1	Intra-controversy	Fundamental scientific controversy, theory, methodology, data collection and analysing
2	Political controversy	Controversy relates to politic, policy making, human right, law and legislation, political and legal interests, such as: GMO law, national vaccination program
3	Economic/ Financial controversy	Controversy relates to business interest, such as GMO corporation, private vaccine service, stem cell trading, AI market
4	Environmental controversy	Controversy relates to natural environment, planet, climate, animal and plant lives...
5	Ethical controversy	Controversy relates to moral principles, ethical standards, religious or cultural values
7	Medical controversy	Controversy relates to health and medical treatment
8	Multi-controversy	More than one controversies are mentioned
9	Others or unclear	Others that cannot be classified in above

Q16. Consequence (Mentioning risk – negative effect and benefit – positive effect)

Q16.1. The presence of risk and benefit

Risk is the situation or possibility of harm or danger or damage. It leads to negative impact. Common discourse of risk is: cost, losing, damage, risk, harm, epidemic, disaster, threat, insecure, critic, uncontrollable.

Benefit is the advantage or profit possibly gained from science and technology development. It leads to positive impact. Common discourse of benefit is: interest, advantage, enjoyment, well-being, convenience, useful, helpful, wonder, novelty, innovation, unexpectedness, surprise, promise.

Code = 0 = Neither risks nor benefits were mentioned

Code = 1 = Only risk was mentioned

Code = 2 = Both of risk and benefit were mentioned

Code = 3 = Only benefit was mentioned

Neither risks nor benefits were mentioned	0
Only risk was mentioned	1
Both of risk and benefit were mentioned	2
Only benefit was mentioned	3

Q16.2. Type of risk

Code = select *one* of the following codes

1	Laboratory	Risk in the laboratory research and experimental process
2	Economy	This includes issues such as: finance, price, trading, market, jobs, salary, agricultural production, software and AI machine market
3	Social issues	This includes issues such as food security, human security, human development, law and

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		legislation, eg. food labelling, robot citizen right
4	Ethical issues	This includes issues such as: human life savings, human values and identity, life cycle, humanity, religion and belief, cultural values. It also includes animal right in laboratory examination
5	Health and medical issues	This includes issues such as: hospital and health care service, medical accident, potential diseases and medical ethics
6	Environment	This includes issues such as endangered species, seeds and plants, environmental sustainability and recycling. This also includes issues surrounding farming when it has an environmental focus and is not related to Economy (2)
7	Mixed	Code as mixed if there are more than one of the above risks
8	Others or Unclear	Code as others if the risk does not fit under any of the above

Q16.3. Type of benefit

Code = select *one* of the following codes.

1	Laboratory	Benefit in the laboratory research and experimental process
2	Economy	This includes issues such as: finance, price, trading, market, jobs, salary, production, service
3	Social issues	This includes issues such as food security, human security, human development, law and legislation, eg. food labelling, robot citizen right
4	Ethical issues	This includes issues such as: human life savings, human values and identity, life cycle, humanity, religion and belief, cultural values
5	Health and medical issues	This includes issues such as: hospital and health care service, medical achievement, potential disease treatments
6	Environment	This includes issues such as the diversity of species, seeds and plants, environmental sustainability and recycling. This also includes issues surrounding farming when it has an environmental focus and is not related to Economy (2)
7	Mixed	Code as mixed if there are more than one of the above benefits
8	Others or unclear	Code as others if the benefit does not fit under any of the above

Q16.4. If risk was mentioned, the intensity of risk (5-point Likert Scale)

Code as	Variable	Protocol
5	Very high risk	If risks are unavoidable and overwhelming
4	High risk	If risks are highly expected and sizeable
3	Moderate	If risks are possible and easy to detect
2	Low risk	For risks shown as rarely occurring and can be mitigated easily
1	Very low risk	When risks were down-played and referenced as insignificant

Q16.5. If benefit was mentioned, the intensity of benefit (5-point Likert Scale)

Code as	Variable	Protocol
5	Very high benefit	If benefits are unavoidable and overwhelming
4	High benefit	If benefits are highly expected and sizeable
3	Moderate	If benefits are possible and easy to detect
2	Low benefit	For benefits shown as rarely occurring and can be mitigated easily
1	Very low benefit	When benefits were down-played and referenced as insignificant

Q16.6. If risk was mentioned, the specificity of risk (5-point Likert Scale)

Code as	Variable	Protocol
5	Very specific	If risks were mentioned and discussed as specific examples or case studies in particular situations
4	Somewhat specific	If risks were mentioned with general examples and discussion
3	Neutral	If risk was mentioned as ambiguous issue
2	Not specific	If risks were discussed as a general topic, like “risks to human life”
1	Not at all specific	If presence of risk was mentioned but not discussed

Q16.7. If benefit was mentioned only, the specificity of benefit (5-point Likert Scale)

Code as	Variable	Protocol
5	Very specific	If benefits were mentioned and discussed as specific examples or case studies in particular situations
4	Somewhat specific	If benefits were mentioned with general examples and discussion
3	Neutral	If benefit was mentioned as ambiguous issue
2	Not specific	If benefits were discussed as a general topic, like “risks to human life”
1	Not at all specific	If presence of benefit was mentioned but not discussed

Q17. Localisation

Q17.1. Locality of the event/ issue

This refers to the geographic origin of the story, where is the event/ story mainly being conducted?

Code = select *one* of the following codes.

If there are more than one location (cross-national), coders should choose the first location mentioned in the article.

1. Vietnam: domestic region
2. International: non-domestic region
3. Unclear : not-mentioned or unclear

Q17.2. If “International”, was the event/ issue localized, such as mentioning local application, local policy, local people?

Code = select *one* of the following codes.

1. Yes
2. No

Q17.3. If “International”, originality of event/ issue

Code = select *one* of the following codes.

1. Mainly original reporting: The article is reported by correspondents or the newsroom’s international reporters and contributors
2. Mainly translated reporting: The article is translated from international sources, including origin scientific source, such as academic journals, research announcement and news source, such as: BBC, The Guardian, Daily Mail, ect.
3. Unclear : Code as other if the its origin does not fit under any of the above

Q17.4. If “Translated”, source of original story

Code = select *one* of the following codes.

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1. Original scientific source: Press release, academic article, scientific report
2. Newspapers or websites: BBC, The Guardian, Daily Mail, ect.
3. Unclear : Code as other if its origin does not fit under any of the above.

Q18. Sources present in the story

Q18.1. Number of source (originator of content)

Code = select *one* of the following codes.

1. No source
2. Single source
3. Two sources
4. More than two sources

Q18.2. Level of sources

Code the first two sources in the story by these above variables

1. Type of source

1	Direct quotation	MUST contain quotation marks or otherwise unequivocal that the phrase is verbatim from the source	<i>E.g Theo Hiều trưởng trường ĐH Y Hà Nội làm đến đâu, làm ở mức độ nào và đối với bệnh lý nào thì cần phải xem xét. “Vì hiện nay thế giới cấm nhân bản người theo mô hình con cừu doly” [According to Principal of Hanoi Medical University, what pathology and how we deal with genetic modification should be considered. "Because the Dolly sheep cloning technique is prohibited to apply for human beings all over the world”</i>
2	Indirect quotation	If the text explicitly refers to what someone said but without the use of inverted commas. It is sufficient that the segment is attributed to	<i>E.g. Chính sách mới cho phép nhập khẩu hạt cải dầu sẽ giúp nông dân tại Canada thúc đẩy sản xuất, theo ông Jim Everson. Chủ tịch Hội đồng Hạt cải dầu, cho biết. [The new policy that allows the import of colza seeds would help Canadian to improve farming productivity, said Jim Everson, President of The Colza Council.</i>

		the source	
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2. Role of source

1	Expert	The person who is specialist in science or is very knowledgeable about a particular area which is related to science, including scientist, professor, health advisor, doctor, ect.	Trưởng nhóm điều tra, giáo sư Dinesh Kant Kumar, RMIT, cho biết phương pháp này rất hiệu quả và không tốn kém. Ông cho biết: "Chúng tôi biết rằng chỉ một nửa số người mắc bệnh tiêu đường được kiểm tra mắt thường xuyên và một phần ba chưa bao giờ được kiểm tra do thiếu phương tiện cũng như chi phí. Phương pháp tiếp cận dựa trên AI của chúng tôi mang lại kết quả chính xác như quét lâm sàng nhưng có thể dựa vào hình ảnh võng mạc được tạo ra bằng thiết bị đo thị lực thông thường. Nhờ vậy, việc chẩn đoán nhanh hơn và rẻ hơn."
2	Lay person	The normal audience who is unprofessional in science and technology	Cùng với gia đình bà Hợp, gia đình ông Phạm Văn Hoàn cũng "bén duyên" với ngô chuyển gen từ 2 năm nay. Ông Hoàn cho biết, ngoài những ưu điểm về kháng sâu đục thân, ngô trồng còn có bắp to, dài, hạt đẹp và không bị bệnh lùn thân, xoắn lá, đổ gãy.
3	Politician	The person who is professionally involved in politics, policy making and enforcement, including local, national and international politician, such as: prime minister, minister, chairman of people council, party secretary, ect.	Dưới góc độ của Nhà nước, Thứ trưởng Bộ Khoa học – Công nghệ Bùi Thế Duy cũng bày tỏ kỳ vọng đưa Việt Nam xếp thứ 29 vào năm 2030, xếp thứ 20 vào năm 2050 theo GDP. Ngoài ra, ông cũng đưa ra những kịch bản có thể xảy ra đối với nền kinh tế số Việt Nam.
4	Non-government	This is someone who is trying to influence the government	Về những tác động của GMO đối với người nông dân, bà Kartini Samon, đại diện Tổ chức Grain (Indonesia) cũng cho rằng, thực tế tại Châu Mỹ - La Tinh, nơi đậu nành biến đổi gen được trồng

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	al worker	and public opinion on behalf of special interests, such as charities, religious groups and activist organizations	trên diện rộng, việc sử dụng thuốc diệt cỏ đã tăng vọt, đạt mức trên 550 lít/năm, gây ra hậu quả đáng lo ngại cho sức khỏe của những người dân nơi đây.
5	Industrial agent	This is someone who represents a specific corporation/business, for example, a business executive or spokesperson	Chủ tịch FPT Trương Gia Bình: "Hãy cho tôi trí tuệ nhân tạo, tôi sẽ đưa Việt Nam vào top 10"
6	New wire	The news agency, such as AP, Reuter, APF, Xinhua...	Chính sách mới của Chính phủ Mỹ nhằm hạn chế sự tiếp cận của Trung Quốc (TQ) vào sáng tạo công nghệ đã gần như chặn đứng dòng vốn đầu tư của TQ vào các công ty khởi nghiệp công nghệ Mỹ, hãng tin Reuters cho biết.
7	Scientific institution	It includes laboratory, university, research centre, research group, journal	Viện khoa học Weizmann cho biết đã cấy thành công 3 loại gen từ củ dền đỏ vào 4 loại cây trồng, mang lại sắc màu tím hay đỏ đặc biệt cho các loại cây. Theo các nhà khoa học, những loại thực vật có màu sắc đặc biệt này có giá trị dinh dưỡng cao và khả năng chống nấm mốc tốt.
8	Public community	Community groups such as neighbourhood watch groups	
9	Governmental organisation	State institutions, including local, national and international organisations	Cục Thống kê cho rằng diện tích ngô (bắp) ở Việt Nam hiện có khoảng 1,1 triệu ha. Tuy nhiên TS. Kha không tin tưởng vào con số này. "Ngành ngô không phát triển và diện tích hiện đã giảm chỉ còn phân nửa. Ngành ngô sẽ nối tiếp ngành bông tụt hậu nhiều khi giá thành quá cao", TS. Kha nhận định.
10	Non-governmental	A professional services organisation, generally hired to conceive, produce and	Theo Tổ chức Y tế Thế giới (WHO), tính đến năm 2017, đã có gần 37 triệu người sống chung với HIV, trong đó hơn 25 triệu người ở châu Phi. Và trong khi sự lây lan của vi rút suy giảm miễn dịch cũng đã giảm từ khi dịch bệnh bùng phát từ những

Appendix

	organisation	manage un-paid messages to the public through the media on behalf of a client, with the intention of changing the public's actions by influencing their opinions. It includes organisation local, national and international institutions	năm 1980, năm 2015, vẫn còn 2,1 triệu người mới nhiễm HIV
11	Industrial or economic complex	A business institution, company, farm, factory, shop, ect	Theo Bkav, hiện có 2 dòng mã độc phổ biến tại Việt Nam khiến người dùng bị mất dữ liệu là dòng mã độc mã hóa tổng tiền ransomware và dòng virus xóa dữ liệu trên USB.
12	Others	Those that cannot be identified as above	

3. Origin of source:

Code = Filling answer in details

1	Local	A region in Viet Nam, such as: province, city, district.
2	National	General Viet Nam
3	Asia	
4	Europe	
5	North America	
6	South America	
7	Australia	
8	Africa	

9	Transitional	International organisation, such as UN, Unesco, World Bank...
10	General or unclear	Not-mentioned or unclear origin of source

Q19. Metaphor

The usage of metaphor

Metaphor is a figure of speech to describe an object or action as a symbol in order to explain an idea or make a comparison. For example: the article compares GMO risk as a monster or symbolises AI as a terminator of the human.

Coder = Choose Yes (1) / No (2) if metaphor is used in each part of article

Headline	Xem siêu bò sữa khổng lồ như "quái vật" biến đổi gen
Lead	Khoảng 150.000 chữ ký của người Mỹ đã khiến kế hoạch thả muỗi biến đổi gen ở Florida phải dừng vô thời hạn. Nhưng dường như "quả bom" vẫn đang chờ nổ...
Body	Taxa không phải một con quái vật khổng lồ về sản phẩm GMO như Monsanto, nhưng công ty vẫn đối mặt với một thách thức tương tự: sự phản đối của người tiêu dùng với các sản phẩm GMO. Evans cho rằng trên thực tế, các sản phẩm GMO không phải thực phẩm có thể tạo ra sự khác biệt với một số người.
Final paragraph	Tiến sĩ Zayner bắt đầu sự nghiệp khoa học của mình với một học bổng trong chương trình Sinh học Tổng hợp của NASA, trong đó ông nghiên cứu về các kỹ thuật với vi khuẩn để phát triển sự sống trên sao Hỏa. Sau đó, ông đã rời khỏi chương trình này để bắt đầu nghiên cứu về công nghệ di truyền của loài người và trở thành tiên phong trong phong trào "hacker sinh học"

Q20. Explicit stance towards issues

In order to measure the extent to which the article is good news or bad news, coders read the final paragraph of the article and make a final judgment on journalist' viewpoint and evaluation of the issue.

Code = 0 = Implicit (article does not express explicit viewpoint/ sentiment)

Appendix

Code = 1 = Opposing

Code = 2 = Neutral/ Balance

Code = 3 = Favour

Favour	Refers to be in favour of S&T. Common discourse includes should apply, recommend, agree, encourage.	3
Neutral/ Balance	Without favour or against S&T. Common discourse: more research or concerns should be conducted in the future	2
Opposing	Refers to be discourse against S&T. Common discourse includes against, should not apply, disagree, opposed to	1
Implicit	Concentrate on fact or information	0

Q21. Call for action or solution

Coders read the final paragraph of the article to identify whether the writer(s) provide(s) any solution or call for any action to solve the controversies?

Code = Coders choose Yes (1) or No (2)

Yes	Muốn vậy cần sự hưởng ứng mạnh mẽ từ các doanh nghiệp Việt Nam, từ việc cung cấp đầy đủ các dữ liệu chân thực, nghiệp vụ đặc thù, cho tới việc chuẩn bị một đội ngũ hỗ trợ các chuyên gia trong quá trình dài hơi tạo ra các sản phẩm TTNT mang thương hiệu thuần Việt.
No	Xu hướng chọn lọc thể hiện rõ rệt khi số startup gọi vốn thành công trong giai đoạn hạt giống giảm từ 39% năm 2017 xuống 30% trong năm 2018

Q22. Aspect of scientific process being mentioned in the article

Code = Coders choose Yes (1) or No (2)

Appendix

	Yes	No
Context and background explained		
Aimed and object explained		
Methodology explained		
Result explained		
Theory explained		
Strength and limitation explained		
Funding (Mentioning the funding source supporting the research)		