JISE 12 (1) (2023): 32-39

Journal of Innovative Science Education

http://journal.unnes.ac.id/sju/index.php/jise

Development of Teaching Material Supplements Based on Socio Scientific Issues to Improve Students' Scientific Argumentation Ability

Khairul Anam✉, Siti Harnina Bintari, Parmin Parmin

Pascasarjana, Universitas Negeri Semarang, Indonesia

Article Info

Article History :
September 2022
Accepted
December 2022
Published
April 2023

Keywords:
Covid-19 pandemic; E-books; Scientific Argumentation; Teaching Material Supplements.

Abstract

The impact of the Covid-19 pandemic has touched every aspect of people's lives, including health and education. Because there is a lot of ignorance about prevention of Covid-19, it is necessary to have learning media that is easily accepted. E-Books are one of the solutions to provide education about the SARS CoV-2 virus which is given to students as a supplement to teaching materials on viruses. The purpose of this study was to test the validity of teaching steel supplements as learning media on viruses and students' scientific argumentation skills. This research uses the Thiagarajan 4-D model development method (Define, Design, Develop, Disseminate). The data analysis technique used is descriptive data analysis including the validity of responses from users and the effectiveness of the products tested on class X MIPA 1 student of SMAN 1 Bandar Lampung. The results showed that the developed e-book had valid criteria by material experts with a score of 75.00% and very valid by media experts with a score of 95.83%. Students and teachers responded to the e-book used in learning, respectively 92.17% and 94.38% with very valid criteria. Analysis of students' scientific argumentation abilities showed moderate criteria with an average N-gain value of 0.52. Thus, the teaching material supplement in the form of an e-book that is being developed can be used as a biology learning medium to improve students' scientific argumentation skills.

✉ correspondence :
Jalan Kelud Utara III No.37, Kota Semarang,
Jawa Tengah, Indonesia 50237
E-mail: kurniasaririris13@gmail.com

p-ISSN 2252-6412
e-ISSN 2502-4523

INTRODUCTION

Since March 2020 the world health organization, known as The World Health Organization (WHO), has declared the Corona Virus Disease (Covid-19) outbreak a global pandemic (Cucinotta & Vanelli, 2020), because the virus has affected more than 200 countries worldwide. world. In Indonesia, we are anticipating the spread of Covid-19 by taking various actions, starting from the obligation to wear masks, washing hands, work from home, study from home, social and physical distancing, large-scale social restrictions (PSBB), and recommendations for quarantine during pandemics also do (Donthu, N., & Gustafsson, 2020.

The Covid-19 pandemic has had an impact on physical, mental, socio-economic, spiritual health and other aspects of society (Poudel and Subedi, 2020). This pandemic causes people to often think negatively and become very sensitive to anxiety, depression, and anger because the virus spreads very quickly (Li et al., 2020). Physical and mental health in times like these need to be properly maintained so as not to cause greater negative impacts (Torales et al., 2020). Conditions like this have a direct impact on all levels of society, especially in the world of education. Schools and informal institutions are required not to carry out face-to-face learning activities and switch to online and offline learning. Changes in learning activities like this are certainly an obstacle for teachers and students, but also a new challenge to improve the quality of learning.

Indonesia is currently implementing an emergency curriculum in special conditions. This emergency curriculum aims to provide meaningful learning experiences and is focused on life skills education, including regarding the Covid-19 pandemic (Anwar, 2020). Implementation of this curriculum was developed based on values that are in accordance with national education goals, directed to the needs of students and consideration of national and international assessments based on PISA (Indah, 2019). Based on the 2018 PISA score in the science category, Indonesia ranks 71st out of 79 countries in the world. This achievement decreased compared to 2015 (Tohir, 2020). It is necessary to increase the understanding of science through learning that develops scientific argumentation skills. The development of scientific argumentation skills has not been widely integrated in biology subjects. Especially on virus material which is currently being the main topic of discussion as a socio-scientific issue (SSI) among the wider community due to the Covid-19 outbreak.

One of the focal points of learning science is developing students' abilities to actively participate in discussions about socio-scientific issues (SSI) in their daily lives (Tsai, 2017). Scientific arguments try to validate on the basis of reasons by reflecting values in the context of science. Currently, scientific argumentation is a pedagogical ability and a core competency in science. The international student assessment program (PISA) organized by the OECD encourages students' ability to use scientific evidence to support claims required in the scientific argumentation component (OECD, 2013).

Based on the results of observations and interviews with teachers at SMAN 1 Bandar Lampung, it was found that in biology lessons the teachers used several instructional media such as printed books, PowerPoint and pictures. Teachers have not used E-book assisted teaching materials as teaching material supplements. In addition, biology learning has not integrated much with scientific argumentation skills, and has not used a variety of strategies, using more of a scientific approach. This requires the development of teaching materials in the form of e-books that are integrated with socio-scientific issues that can be used optimally in biology learning to improve students' scientific argumentation skills.

Many e-book-based teaching materials have been developed, for example by (Billah & Sarwanto, 2021) who produced android-based teaching materials on natural science material. In addition, (Muhlas & Kuntjoro, 2019) is an ebook based on scientific literacy on ecological material. By (Hoiroh, 2020), namely the development of a booklet on mushroom material. As well as (Kartika & Kurniasih, 2017) developing teaching materials based on socio-scientific issues in biotechnology material. From previous research, there has been no development of teaching material supplements in the form of ebooks based on socio-scientific issues on viruses to improve scientific argumentation skills.

Based on the background that has been described, it is necessary to develop teaching material supplements in the form of e-books based on socio-scientific issues in schools in biology

lessons, especially on viruses to improve students' scientific argumentation skills. It is hoped that it can be used as an indicator for teachers to determine the success of students in understanding subject matter at school.

METHOD

This research is a development research based on the 4-D model of Thiagarajan et al. (1974) which includes 4 stages: define, design, develop and disseminate. The define stage includes facts and a series of needs in learning Biology at SMA Negeri 1 Bandar Lampung. The second stage of the design includes the development of learning materials and the creation of an initial e-book design based on socio scientific issues using the Flip PDF Corporation application. The third stage is develop which includes the development of an e-book with text, graphics, video, and format selection as well as conducting trials on students. The final step is to disseminate by providing limited soft files and links to the final results of the e-book to the biology subject teachers at SMA Negeri 1 Bandar Lampung. This research was conducted at SMA Negeri 1 Bandar Lampung in class X MIPA 1 and MIPA 2. The research was conducted in the 2022/2023 school year from August-September 2022.

Research data includes media validation data using a validation questionnaire given to material and media expert lecturers by attaching a questionnaire and e-book link that has been developed, practicality questionnaire by teachers and readability questionnaire by students after using the e-book in a limited trial. Data collection was through pretest and posttest using 30 reasoned multiple choice questions to measure students' scientific argumentation abilities. Data from material and media validators, teacher practicality and student readability were analyzed using the Likert scale while pretest and posttest data were analyzed using the N-Gain test.

RESULT AND DISCUSSION

in the form of an e-book includes two components, namely the material component and the media component. E-books are declared valid if the assessment of material and media experts achieves an average percentage score of > 62%, or the criteria are valid and very valid. The total expert assessment of supplementary material for e-book teaching materials based on socioscientific issues is presented in Table 1.

Table 1. Socio scientific-based e-book validation of viral material based on material experts

No.	Aspect	Score	Maximum Score	Score	Category
1.	Content	36	48	75.00	Valid
2.	Language	23	32	71.88	Valid
3.	Characteristic	24	36	66.67	Valid
4.	SSI Aspect	25	28	89.29	Very Valid
5.	Total	108	144	75.00	Valid

Based on Table 1, the validity of e-books based on socioscientific issues in viral material according to material experts from four aspects is considered to have a total score of 75.00% with valid criteria, meaning that each component gets a good rating from material experts. The material expert's assessment shows that the presentation components and content feasibility are quite as expected. Conformity includes 1) the contents of the components are appropriate; 2) the techniques presented are good; 3) good presentation completeness; 4) description of the material in accordance with the basic competencies; and 5) the accuracy of the material is good. In line with Wahyuningsi et al (2014) that validation of the feasibility aspect of the content will be good if the material presented is good and in accordance with basic competencies. The results of validation by media experts of e-books based on socioscientific issues on virus material can be seen in Table 2.

Table 2. Socioscientific Based E-Book Validation Results on Virus Material Based on Media Experts

No.	Aspect	Score	Maximum Score	Score	Category
1.	Size	7	8	87.50	Very Valid
2.	Design	26	28	92.86	Very Valid
3.	Content *e-book*	59	60	98.33	Very Valid
4.	Total	92	96	95.83	Very Valid

Based on Table 2, the validation results by media experts show that the components of size, design, and content of the e-book are as expected, these components include 1) suitability of size with the material; 2) clearly presented images; 3) the fonts presented are very suitable for each component; 4) the layout presented is attractive; 5) easy to operate in learning activities. Therefore, according to media experts, the validity of e-books based on socioscientific issues on viral material is very valid with a total value of 95.83%, which means it is very feasible to use.

The material validation carried out aims to obtain validity of the content of the virus material on the subject of SARS CoV-2 in an e-book based on socioscientific issues. Material experts provide comments and suggestions that there are some mistakes in typing and are advised to be more careful. For example, writing the name of the virus must comply with ICTV (International Committee on Taxonomy Of Viruses). Previously, in an e-book that was developed, the name of the virus that causes Covid-19 disease was novel coronavirus, but according to ICTV, the real name was SARS CoV-2 (severe acute respiratory syndrome coronavirus-2) (Zheng, 2020). In addition, there are no sources for images, infographics, and videos included in the e-book. Providing sources is ethical writing and respecting copyright. Based on the suggestions given by material experts, the e-book was revised by adding sources to images, infographics and videos. In line with Murfianti's (2020) opinion that the use of copyrighted works must include a source or reference in the digital data header.

Previously, many wrote the wrong virus variants, such as the alpha and omicorn variants of covid-19, because covid-19 is the name of the disease that became a pandemic, not the name of the virus, then the virus naming was revised to become the SARS CoV-2 virus, the omicron variant, this is in accordance with Lauring's opinion & Malani (2021) that the SARS CoV-2 virus mutated into various variants such as alpha, beta, delta, gamma, and omicron variants.

Media revision in the form of suggestions for improvement obtained from media experts, namely adding the name of the supervising lecturer because it has not been included in the e-book, besides changing the concept map to a material map and not including the source of the images included in the e-book, then the e-book revised according to the advice of media experts. Not much advice was given by media experts because in general it was good. The assessment data of media experts and material experts is used as a basis for revising the e-book which was developed to improve the components of the e-book before being tested on students.

Responses to student readability and practicality by teachers were also used to revise efforts to improve e-books based on socioscientific issues on viral material. E-books that were declared valid by material and media experts and had gone through the revision stage were then tried out in schools to find out the response of teachers and students. The trial was conducted at SMA Negeri 1 Bandar Lampung with 20 students and two teachers.

Student responses to the legibility of the SSI e-book on viruses as a teaching material supplement were carried out by filling out a questionnaire. The positive response to the e-book with an average percentage of 92.17% and included in the very good category. This shows that the SSI e-book on viruses as a learning supplement is suitable for use as a learning medium.

Student questionnaire analysis on the appearance and content aspects of ebooks has criteria for ease of use, pictures, text and writing of e-books that are interesting so that they can help understand better about the SARS CoV-2 virus. The use of contextual learning also provides examples of events related to learning materials. The developed e-book also contains socioscientific-based issues about the SARS CoV-2 virus that occur in everyday life so that it can improve students' argumentation abilities in learning materials. The use of e-books

that can be accessed anywhere makes it easier for students to learn.

Table 3. SSI-based Practicality Assessment of Virus Material by the Teacher

No.	Aspect	Score	Maximum Score	Score	Category
1.	Presentation	18	20	90.00	Very good
2.	Content	23	24	95.83	Very good
3.	Language	19.5	20	97.50	Very good
4	Appropriateness	15	16	93.75	Very good
Total		75.50	80	94.38	Very good

The results of the teacher's response assessment obtained a score of 94.38% which was classified as very good criteria. E-books have an attractive presentation so that e-books can help students have scientific argumentation skills because they are supported by contextual problems that are being experienced by students. The terms used in the e-book are simple so that students can easily understand them. E-books based on socio-scientific issues of viral material as teaching material supplements are considered very valid for learning, teachers suggest that e-books can be used as a companion to existing books because the information presented does not overlap but complements each other. Textbooks in schools place more emphasis on material concepts, but contextual learning on current issues that are happening in society is minimal, especially on virus material.

E-books equipped with pictures and videos make it more interesting. In line with the opinion of Kuswanto & Radiansah (2018) who say that learning media with an attractive appearance greatly influences the learning process. The existence of pictures and videos in e-books also makes it easier to convey material to students so that students understand the material better (Laili, 2019).

Students' scientific argumentation abilities were measured using pretest and posttest questions. After the results of the pretest and posttest were obtained, the data were processed using the N-gain test. The N-gain test is used to measure the difference between the pretest and posttest scores. Based on the pretest and posttest results, it is known that the average student argumentation ability has increased. The results of the N-Gain analysis are presented in Table 4.

Table 4. Students' Scientific Argumentation Ability Score

Data	Score	N-Gain	Criteria
Lowest Pretest	27	0.52	Medium
Highest Pretest	65		
Lowest Posttest	65		
Highest Posttest	92		
Pretest Average	48		
Posttest Average	76		
Class Control	Score	N-Gain	Criteria
Lowest Pretest	27	0.40	Medium
Highest Pretest	53		
Lowest Posttest	47		
Highest Posttest	82		
Pretest Average	39		
Posttest Average	64		

Data on improving students' scientific argumentation skills were obtained from the pretest and posttest scores given after being given treatment. The average n-gain scientific argumentation ability at SMA Negeri 1 Bandar Lampung in the experimental class using teaching material supplements in the form of virus material ebooks

and the control class using textbooks provided by the school are presented in the following bar chart :

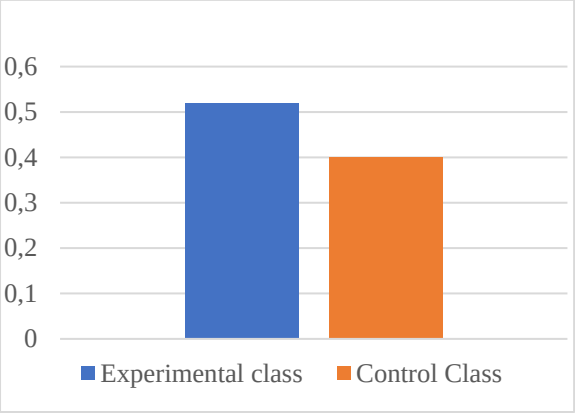

Figure 1. N-Gain Differences in Student Scientific Arguments

Based on Figure 1, it is obtained that the N-Gain value for the control class (X MIPA 2) is 0.40 in the medium category and the experimental class (X MIPA 1) is 0.52 in the moderate category. This is in accordance with research conducted by Siska (2020) and Martini et al (2021) regarding the application of SSI learning which can improve scientific argumentation abilities. The development of SSI-based teaching materials can also improve scientific argumentation skills (Tekin et al., 2020).

SSI-based learning is in accordance with issues that are rife in society. the application of scientific knowledge and/or concepts in society is the realization of students' knowledge at school (Alindra & Ana, 2018). Learning using SSI learning stages can improve scientific argumentation skills, this is because in SSI learning students try to find factual data or scientific evidence to solve contraversional science issues in society that are influenced by social, ethical and moral norms (N. P. Anwar & Ali , 2020). In accordance with Libman (2010) explains that in the learning process students learn more easily from examples that are closest to their daily lives.

These results can be the basis for stating that the use of teaching material supplements in the form of SSI-based e-books on viruses has a significant effect on students' scientific arguments. The reason is that SSI in biology learning e-books can make students aware of issues that are close to the community and their impact on the life of the community itself (Arsyim et al., 2022). According to Ika Noviyanti et al (2019) argumentation skills can improve academic abilities because students discover and process scientific data to solve a problem. Providing arguments against answers given by other people in learning also makes the learning carried out by students more meaningful (Agoestanto et al., 2019).

The teaching material supplement in the form of an SSI-based e-book on virus material was developed by utilizing computer and smartphone platforms as a medium for conveying the content of biology material. ¬ e-books can be accessed using the internet online or using files transferred to a computer device so that they can be accessed offline. Online learning is defined as a type of learning that allows teaching materials to be delivered to students using internet media or other computer network media (Herayanti, Fuaddunnazmi, & Habibi, 2015).

Learning that involves technology can have a positive impact on the process of transforming conventional education into digital, both in terms of content and system (Wahid, 2015).

The development of computer technology presents opportunities for innovations in biology learning, one of which is the e-book. e-book is a presentation of self-learning material that is systematically arranged into the smallest learning units to achieve specific learning presented in an electronic format where there are animations, audio, navigation to make users more interactive with the program. Learning becomes more interesting, interactive, can be done anytime and anywhere and can improve the quality of learning (Perdana, 2017). The SSI approach will provide an atmosphere related to issues circulating in society in the hope that they can develop their knowledge through searching for evidence or facts and data by carrying out technological innovations to solve counterversional problems (Khasanah & Setiawan, 2022).

The teaching material supplement product in the form of an SSI-based e-book on virus material resulting from this study is effective in increasing scientific argumentation skills. This is because as a function as teaching material, the developed e-book contains a set of planned and designed learning experiences to help students master specific learning objectives.

CONCLUSION

Based on the research that has been done, it can be concluded that the teaching material supplement in the form of an e-book based on socioscientific issues on viral material as a valid learning media based on material experts and media experts and is effective for use in learning based on the N-gain obtained. There is a significant difference in increasing the ability of scientific argumentation between students who use e-books and students who do not use e-books in learning activities. the average n-gain for the experimental class is 0.52 (medium), while the control class is 0.40 (medium).

REFERENCES

Agoestanto, A., Sukestiyarno, Y. L., & Permanawati, F. I. (2019). Kemampuan Menganalisis Argumen dalam Berpikir Kritis Ditinjau dari Rasa Ingin Tahu. *Prisma*, *2*, 337–342.

Alindra, A. L., & Ana, A. (2018). Argumentation and Reasoning Skills In Socioscientific Issues. *Innovation of Vocational Technology Education*, *14*(2), 44. https://doi.org/10.17509/invotec.v14i2.14356

Anwar, N. M. (2020). *Surat Edaran No 4 Tahun 2020 Tentang Pelaksanaan Kebijakan Pendidikan dalam Masa Darurat Penyebaran Covid-19*. Kementerian Pendidikan dan Kebudayaan Direktorat Jendral Guru dan Tenaga Kependidikan.

Anwar, N. P., & Ali, M. A. (2020). The Effect Of Socio-Scientific Issue (SSI) Based Discussion: A Student-Centred Approach To The Teaching Of Argumentation. *SOTL in the South*, *4*(2), 35–62. https://doi.org/10.36615/sotls.v4i2.76

Arsyim, I., Rubini, B., & Pursitasari, I. D. (2022). Socio Scientific Issues-Based Argumentation Assessment for Middle School Students. *Jurnal Penelitian Pendidikan IPA*, *8*(2), 1034–1041. https://doi.org/10.29303/jppipa.v8i2.844

Billah, A., & Sarwanto, S. (2021). Pengembangan Media Pembelajaran IPA Pokok Bahasan Mata Manusia Berbasis Android. *Inkuiri: Jurnal Pendidikan IPA*, *9*(2), 94. https://doi.org/10.20961/inkuiri.v9i2.50070

Cucinotta, D., & Vanelli, M. (2020). *WHO Declares COVID-19 a Pandemic*. *91*(6), 157–160. https://doi.org/10.23750/abm.v91i1.9397

Donthu, N., & Gustafsson. (2020). *Journal of Business Research*. *6*(8), 284–289. https://doi.org/10.1016/j.jbusres.2020.06.008

Hoiroh, A. M. M. (2020). Pengembangan Media Booklet Elektronik Materi Jamur untuk Meningkatkan Pemahaman Konsep Siswa Kelas X SMA. *BIOEDU Berkala Ilmiah Pendidikan Biologi*, *9*(1), 292–301. https://ejournal.unesa.ac.id/index.php/bioedu/article/view/36753%0Ahttps://ejournal.unesa.ac.id/index.php/bioedu

Kartika, I., Kurniasih, I. D. P. (2017). *Kata Kunci: Bahan Ajar; Bioteknologi; Literasi sains ; Socio Scientific Issues*. *10*(2016), 1–12.

Ika Noviyanti, N., Rosyadah Mukti, W., Dahlia Yuliskurniawati, I., Mahanal, S., & Zubaidah, S. (2019). Students' scientific argumentation skills based on differences in academic ability. *Journal of Physics: Conference Series*, *1241*(1). https://doi.org/10.1088/1742-6596/1241/1/012034

Indah, P. (2019). *Efek Program Pisa Terhadap Kurikulum di Indonesia*. *4*(1), 51–71.

Khasanah, S. U., & Setiawan, B. (2022). Penerapan Pendekatan Socio-Scientific Issues Berbantuan E-Lkpd Pada Materi Zat Aditif Untuk Meningkatkan Literasi Sains Siswa. *Pensa E-Jurnal : Pendidikan Sains*, *10*(2), 313–319. www.liveworksheet.com

Laili, I., Ganefri., Usmeldi. (2019). Efektivitas Pengembangan E-Modul Project Based Learning Pada Mata Pelajaran Instalasi Motor Listrik. *Jurnal Imiah Pendidikan dan Pembelajaran*, 3 (3)

Lauring, A. S., & Malani, P. N. (2021). Variants of SARS-CoV-2. *JAMA - Journal of the American*

Medical Association, *326*(9), 880. https://doi.org/10.1001/jama.2021.1418

Li, S., Wang, Y., Xue, J., Zhao, N., & Zhu, T. (2020). The Impact of Covid-19 Epidemic Declaration on Psychological Consequences: A Study on Active Weibo Users. Int J Environ Res Public Health [Revista en Internet] 2020 [acceso 13 de abril de 202021]; 30(3): 201-205. *International Journal of Environmental Research and Public Health*, *17*(6). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7143846/pdf/ijerph-17-02032.pdf

Martini, Widodo, W., Qosyim, A., Mahdiannur, M. A., & Jatmiko, B. (2021). Improving Undergraduate Science Education Students' Argumentation Skills Through Debates on Socioscientific Issues. *Jurnal Pendidikan IPA Indonesia*, *10*(3), 428–438. https://doi.org/10.15294/JPII.V10I3.30050

Muhlas, & Kuntjoro, S. (2019). Development of E-Book Using Flip Book Type Based Science Literacy. *Berkala Ilmiah Pendidikan Biologi (BioEdu)*, *8*(1), 58–62. http://ejournal.unesa.ac.id/index.php/bioedu

Poudel, Kritika and Subedi. (2020). *Impact of Covid-19 pandemic On Socioeconomic And Mental Health Aspects in Nepal*. https://doi.org/10.1177/0020764020942247

Siska, S., Triani, W., Yunita, Y., Maryuningsih, Y., & Ubaidillah, M. (2020). Penerapan Pembelajaran Berbasis Socio Scientific Issues Untuk Meningkatkan Kemampuan Argumentasi Ilmiah. *Edu Sains Jurnal Pendidikan Sains & Matematika*, *8*(1), 22–32. https://doi.org/10.23971/eds.v8i1.1490

Tekin, N., Aslan, O., & Yılmaz, S. (2020). Improving Pre-Service Science Teachers' Content Knowledge and Argumentation Quality through Socio-Scientific Issues-Based Modules: An Action Research Study. *Journal of Science Learning*, *4*(1), 80–90. https://doi.org/10.17509/jsl.v4i1.23378

Thiagarajan, S; Semmel, D.S; & Semmel, M.I. (1974). Instructional Development for Training Teachers of Exceptional Children: A Sourcebook. Indiana: Indiana University

Tohir, M. (2020). *Hasil PISA Indonesia Tahun 2018 Turun Dibanding Tahun 2015*. 10–12. https://doi.org/10.17605/OSF.IO/8Q9VY

Torales, J., O'Higgins, M., Castaldelli-Maia, J. M., & Ventriglio, A. (2020). The Outbreak of Covid-19 Coronavirus and Its Impact On Global Mental Health. *International Journal of Social Psychiatry*, *66*(4), 317–320. https://doi.org/10.1177/0020764020915212

Tsai, C. (2017). The Effect of Online Argumentation of Socio-Scientific Issues On Students' Scientific. *Computers & Education*. https://doi.org/10.1016/j.compedu.2017.08.009

Wahyuningsih F, Sulistyo S & Sri M (2014) Pengembangan LKS Berbasis Inkuiri Terbimbing Pada Materi Pokok Hidrolisis Garam untuk SMA/MA. *Jurnal Paedagogia.* 17 (1): 94-103.

Zheng, J. (2020). SARS-coV-2: An Emerging Coronavirus that Causes a Global Threat. *International Journal of Biological Sciences*, *16*(10), 1678–1685. https://doi.org/10.7150/ijbs.45053