The Asian Journal of Biology Education

ISSN 1447-0209

Volume 15: November 2023

The Asian Journal of Biology Education (AJBE) is published electronically by the AJBE Editing and Publishing Office for the Asian Association for Biology Education (AABE). The Journal is on the AABE website: **http://www.aabe.sakura.ne.jp/Journal. htm**

The Asian Journal of Biology Education

Volume 15: November 2023

Asian Journal of Biology Education, 2023
https://doi.org/10.57443/ajbe.15.0_2

Opinion

The Need for Education about Threats to Biodiversity and Loss of Ecosystem Function in the Corporate Sector

Robert WALLIS*
Federation University, Australia

(Received: 19 November 2022; Accepted for publication: 3 January 2023)

Over half the world's economic output depends on natural assets and future healthy ecosystems will be essential for our continued survival. While both public and private sector corporations have been active in finally addressing the threats posed by climate change, there has been little focus on the wider implications of a decline in the world's natural capital. Company boards have an important responsibility to play in addressing this challenge. Some possible solutions are presented, and the role of biology educators will be especially important.

Key words: *Biodiversity, boards, corporate sector, education, natural capital*

***Robert Wallis**, Email: r.wallis@federation.edu.au

INTRODUCTION

More than half of the world's economic output, estimated at US$ 44 trillion, is dependent on nature and its services (World Economic Forum, 2020). However, investors, lenders and corporations in general have been slow to recognize the threats and opportunities of natural capital – the natural assets that provide natural resources inputs and environmental services for economic production (United Nations *et al.*, 2005).

The corporate sector, especially large industries and commercial enterprises, have in the past been focused on delivering profit and other short-term objectives to their owners and shareholders. Recently, responding to shareholder activism, public concerns, stakeholder pressure and government regulations, they have increased efforts to decarbonize their operations and quantify their role in combating climate change. Corporations are also responding to environmental, social and governance (ESG) risks, including such things as reducing their dependence on fossil fuels, ensuring their supply chains are free from slavery and child labour and ensuring proper process is followed in human resources management in terms of harassment, equal opportunity and anti-discrimination. Superannuation funds in Australia have been investing in ethical operations and using their influence to drive ESG (Kitney, 2022). Corporations are now aware of the fragility of the 'social licence' to operate; social licence is now much more than just complying with environmental regulations.

Given their dependency on natural capital, corporations should assess their nature footprint to focus on more than just climate change but consider wider implications of environmental change, especially loss of biodiversity and loss of ecosystem integrity.

WHY CONSERVE BIODIVERSITY?

Biodiversity is the total of all living things in an area. It not only includes the range of all forms of life such as bacteria, protista, fungi, plants and animals, but also their genes.

Biodiversity must be maintained. While some argue biodiversity must be kept for ethical reasons (it is wrong for us to exterminate other life forms) or aesthetic reasons (we should not destroy the beauty of nature), there are more important pragmatic reasons that directly affect our own future survival and well-being. These are based on the concept of *ecosystem services*. The European Commission (undated – see Website list) describe these services thus:

"Healthy ecosystems clean our water, purify our air, maintain our soil, regulate the climate, recycle nutrients and provide us with food. They provide raw materials and resources for medicines and other purposes. They are at the foundation of all civilization and sustain our economies. It's that simple: we could not live without these ecosystem services."

These beneficial ecosystem services can be classified into four categories: provisioning services (such as food, water, fuels, medicines), regulating services (purifying air and water), flood and disease control, cultural services (spiritual wellbeing, recreational needs) and supporting services (such as pollination, primary production, nutrient cycling) (Chivian and Bernstein, 2010; Department of the Environment, Water, Heritage and the Arts, 2009).

There has been incontrovertible evidence that the world's climate is undergoing major change, and this can impact on biodiversity. For example, recent floods and bushfires in Australia have been the most widespread and destructive in recorded history. One of these impacts has been loss of biodiversity across large areas and the resultant loss of ecosystem function. The bushfires in the Australian State of Victoria in 2019-2020 are a case in point. They covered an area of 1,511,000 ha, affected 79% of known habitat of an endangered marsupial, the Long-footed Potoroo (*Potorous* longipes) and 43% of the critically endangered Brush-tailed Rock-wallaby (*Petrogale penicillata*) with fewer than 30 animals living in the wild before the fires (Department of Environment, Land, Water and Planning, Melbourne, Victoria: DELWP, 2020). The situation for frogs and fish in Victoria is even more dire with around 90% of habitat loss affecting some species. The intensity of the fires left vast tracts of land denuded of living vegetation and subsequently caused large scale erosion and siltation of rivers (DELWP, 2020). Across Australia, these fires killed 420 people. A heat-wave in Australia in 2018 killed 23,000 of the Spectacled Flying-fox (*Pteropus conspicillatus*), an important pollinator, driving its conservation status to endangered (Gittens, 2022). Australia has also experienced three years of La Ninã weather conditions (2020-22), resulting in massive floods – the worst in over 100 years in Victoria.

Climate change is but one of the six major causes for the decline in biodiversity and threats to nature in Australia. Others are habitat change, fire, invasive species, unsustainable resource use and aquatic ecosystem changes caused by changed water flows (Department of Sustainability, Environment, Water, Population and Communities, 2010).

CORPORATE GOVERNANCE

The corporate sector has a major role to play in conserving biodiversity especially since their sustainability depends on healthy ecosystems.

Many corporations, in both the private and public sectors, are governed by a board of directors that represent the interests of their shareholders, members or government. Directors oversee management to ensure compliance, risk and financial sustainability and growth. They develop the strategy including vision, mission and other high level strategic statements such as risk appetite. Most importantly, they appoint and monitor the performance of the Chief Executive Officer (CEO).

In the past the corporate sector concerns have mainly been with profit. Boards have typically been made up of industry experts (especially former CEOs), accountants and lawyers. While all members were meant to have basic financial literacy, the specialists enabled deep dives into financial and economic matters that supported boards' audit and risk committees.

More recent challenges have led to repeated calls for boards to include expertise in information technology (IT) and cybersecurity (AICD, 2022 – see Website list; Conrad, 2022; LeBlanc, 2022 - see Website list). The recent 2022 breach of security at Australia's Medicare Private health insurance led to ransomware extortionists accessing and releasing personal health records of 9.7 million Australians, reinforcing the call for boards to have more skills and expertise in IT.

Others have urged boards become more educated in science, technology, engineering and mathematics (STEM), including appointing scientists as directors (AICD, 2020 – see Website list). The Australian Chief Scientist Annette Foley has challenged companies and their boards to consider how science and technology can affect their organisations and how to better use scientific research (Courtney, 2022).

Similarly, corporations and businesses of all sizes need to address the impact they may be having on the destruction of natural capital. This impact is an important board responsibility. While shareholder activism, political, customer and community pressure has seen a marked increase in boards addressing their responsibilities to climate change and decarbonization (for example, Efrat, 2022; Niesche, 2022a), there is an equally urgent need for boards to address their organizations' responsibilities towards biodiversity and natural capital decline and restoration of impacted ecosystems. Biodiversity loss and ecosystem collapse are in the top five emerging global risks listed by the World Economic Forum (World Economic Forum, 2020).

If companies' activities deleteriously affect biodiversity and ecosystem health, profitability can be diminished as, for example, resources for human needs become unavailable. Reputational damage can lead to loss of business. Nature thus really matters to boards, investors and business in general (Shrivastava, 1995; World Economic Forum, 2020; Leeshaa, 2022; Summerhays and Waterford, 2022).

THE WAY FORWARD

Corporate boards therefore have a responsibility to reduce their organizations' impact on nature's capital. How best to achieve this?

1. Board membership. While it will be important for all directors to become "nature literate", having an ecologist with specialist insights into ecosystem function and biodiversity is a simple way to ensure nature capital is addressed by a board. The ecologist could help undertake "deep dives" into aspects of the business' impacts on the environment and help guide appropriate reporting and interpretation of these reports. Some boards already

mandate that at least one member has such specialist skills – for example, at least one director on the board of Parks Victoria, an Australian state government authority, must have conservation expertise and qualifications.

2. Board policies. A spectrum of board initiatives in ESG exist. At one end, boards may simply have a steering or working group that addresses sustainability issues. At the other end, a formal board committee dedicated to ESG exists, there are formal sustainability mandates, accounting systems that take into account natural capital and a formal board-led sustainability strategy (Hendy, 2022). A sustainability strategy might not just consider net zero carbon emissions, but net positive nature goals, where biodiversity is enhanced and augmented through conservation and restoration by the corporation's activities.
3. Key management appointments. 14% of companies in the Asia-Pacific region now have a Chief Sustainability Officer who plays a vital role in embedding ESG to join other "C-suite" leaders in finance, IT, risk and so on. Hendy (2022) notes these appointments traditionally have been focusing on the organisation's decarbonization and energy, but they will be expected to address nature in the future.
4. Professional development opportunities for directors. This could involve seminars, workshops, lectures, courses and other educational experiences to upskill existing board members in the field of biodiversity, ecosystem services, natural capital, environmental accounting and nature-positive strategies. Biology educators have a role to play in designing and delivering fit-for-purpose curricula. They also need to work with accountants and economists so that natural assets are valued, and environmental accounts are included in corporate reports.
5. Educators also have an important role to play in educating the wider community on ecology to prevent the misuse and misinterpretation of terms and concepts such as *ecosystem*, *DNA*, *ecological resilience* and *biodiversity*. Phrases such as "the business ecosystem" and "maximizing returns for investors is in our DNA" are confusing and bring into question the user's expertise in their own specialization. Biology educators can also help identify "greenwashing" where companies give an impression of acting in an environmentally aware and sustainable fashion but are merely ticking the boxes for marketing and reputation purposes (Tarrant, 2022 – see Website list).
6. Biology educators also have a role to play in working with scientists and government to properly regulate biodiversity conservation. A review of Australia's environmental laws has revealed they are not addressing the rapid decline in natural capital. In response, the Australian government has promised to introduce wholesale reform of the environmental legislation (Niesche, 2022b).
7. Global initiatives. The Taskforce on Nature-related Financial Disclosures (TNFD, 2022 – see Website list) has been set up to help the drive for nature being built into financial and business decisions. The TNFD closely follows the earlier development of the Taskforce on Climate-related Financial Disclosures; both movements align with the requirements of the International Sustainability Standards Board. Importantly, the TNFD is science-based and government supported across the world. It aims "to develop and deliver a practical and globally consistent risk management and disclosure framework that enables corpo-

rates and financial institutions to assess, manage and report on their dependencies and impacts on nature" (Leesha, 2022, p. 30). The Australian Government's Department with responsibilities for environment helps fund the TNFD and will be facilitating workshops with peak Australian bodies in business, industry, investors and shareholders. The final framework should be introduced in September 2023 and will include feedback from these and other consultations.

CONCLUSION

There is an urgent need for the corporate sector to consider the impacts their activities have on the world's natural capital and how global declines in biodiversity and ecosystem services will affect their operations, continued profitability and society. There is a groundswell of activity to address the decline in health and functioning of ecosystems, but all levels of business, the community and government need to respond quickly. Biology educators can play a significant role in helping formulate such a response.

As the IUCN has stated, "Nature's Future is Our Future" (IUCN, 2021 – see Website list).

ACKNOWLEDGEMENT

I am most grateful for the thoughtful comments and advice from Dr Helen Scarborough and two anonymous referees whose critical reviews has led to significant improvements in this article.

REFERENCES

Chivian, E. and Bernstein, A. (2010) *How Our Health Depends on Biodiversity.* Center for Health and the Global Environment, Harvard University, Cambridge, USA.

Conrad, M. (2022) Putting cyber governance principles to work. *Company Director* **38** (10): 34-40.

Courtney, A. (2022) Science project. *Company Director* **38**(1): 28-32.

Department of the Environment, Water, Heritage and the Arts (2009) *Ecosystem Services: Key Concepts and Applications. Occasional Paper No. 1.* https://www.agriculture.gov.au/sites/default/files/documents/ecosystem-services.pdf < accessed January 3, 2023>

Department of Environment, Land, Water and Planning, Melbourne, Victoria (2020) *Victoria's Bushfire Emergency: Biodiversity Response and Recovery, Version 2.* https://www.wildlife.vic.gov.au/__data/assets/pdf_file/0030/484743/Victorias-bushfire-emergency-Biodiversity-response-and-recovery-Version-2-1.pdf < accessed January 3, 2023>

Department of Sustainability, Environment, Water, Population and Communities (2010) *The Australian Biodiversity Conservation Strategy 2010 – 2030*. https://www.planning.vic.gov.au/__data/assets/pdf_file/0021/213717/Background-Documents-Commonwealth-Biodiversity-Conservation-Strategy-2010.pdf < accessed January 3, 2023>

Efrat, Z. (2022) What's on the watch list. *Company Director* **38**(9): 66-69.

Gittens, R. (2022) Knock-on impact of sick nature. *The Age,* 3 August 2022, p. 18.

Hendy, N. (2022). Value-add or vanity? *Company Director* **38**(10): 56-61.

Kitney, D. (2022) Dancing with elephants. *Company Director* **38**(9): 17-23.

Leesha, C. (2022) Natural selection. It's time for directors to recognize and deal with rising risks and opportunities by offering nature a place at the boardroom. *Company Director* **38**(6): 30-31.

Niesche, C. (2022a) Mission zero. *Company Director* **38**(9): 48-52.

Niesche. C. (2022b) Before it's too late. *Company Director* **38**(10): 22-25.

Shrivastava, P. (1995) The role of corporations in achieving ecological sustainability. *Academy of Management Review* **20**(4): 936-960. https://www.jstor.org/stable/258961?origin=crossref

Summerhays, G. and Waterford, L. (2022) Back to nature. Business should be aware of the broader risk implications of the destruction of our global 'natural capital'. *Company Director* **37**(9): 30-31.

United Nations, European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development, and the World Bank (2005) *Handbook of National Accounting: Integrated Environmental and Economic Accounting 2003.* Studies in Methods, Series F, No. 61, Rev. 1, Glossary. United Nations, New York.

World Economic Forum (2020) *Nature Risk Rising: Why the Crisis Engulfing Nature Matters for Business and the Economy.* World Economic Forum, Geneva.

WEBSITES

AICD (2020) *Does your board have the STEM skills it needs?* https://www.aicd.com.au/board-of-directors/performance/skills-matrix/does-your-board-have-the-stem-skills-it-needs.html <accessed December 1, 2022>

AICD (2022) *Study reveals more needs to be done to secure cybersecurity resilience*. https://www.aicd.com.au/news-media/media-releases/2022/study-reveals-more-needs-to-be-done-to-improve-cybersecurity-res.html <accessed December 10, 2022>

European Commission (undated) *Why do we need to protect biodiversity?* https://ec.europa.eu/environment/nature/biodiversity/intro/index_en.htm <accessed November 1, 2022>

IUCN: International Union for the Conservation of Nature (2021) Nature's future, our future – the world speaks out. https://www.iucn.org/news/protected-areas/202102/natures-future-our-future-world-speaks <accessed September 21, 2022>

LeBlanc, R. (2022) *IT skills needed around the board table*. https://boardexpert.com/it-skills-needed-around-the-board-table/ <accessed October 31, 2022>

Tarrant, D. (2022). *Beware the risk of greenwashing*. https://www.aicd.com.au/risk-management/framework/climate/beware-the-risk-of-greenwashing.html <accessed November 21, 2022>

TNFD: Taskforce on Nature-related Financial Disclosures (2022) *Developing and delivering a risk management and disclosure framework for organisations to report and act on evolving nature-related risks.* https://tnfd.global/ <accessed October 11, 2022>

Asian Journal of Biology Education, 2023
https://doi.org/10.57443/ajbe.15.0_8

Country Report

Borderless Classroom for Biology Teaching and Learning in Malaysia during COVID-19 Pandemic Time with Professional Learning Community (PLC)

Siew Wai, KWAN*
SMK Vivekananda, Brickfields, Malaysia

(Received: 19 September 2022; Accepted for publication: 8 February 2023)

Despite the hectic which COVID-19 created since 2020, it indeed promoted great advancement in teaching and learning. Over the years, educators were working together in making lessons interesting and achievable by learners, especially those in rural areas. Somehow, due to many constraints like location, finance, transportation, accessibility and facilities, the effort seemed not rewarding as it was planned. In 2020 and 2021, schools were in lockdown, resulting in the mushroomed of virtual classes. In Malaysia, led by the Ministry of Education, followed by the District Education Departments, schools, educators and other partners, various materials for virtual classes were enhanced and developed. This seemed to facilitate a borderless classroom, especially for biology lessons. Biology teachers collaborated in conducting borderless classroom with Professional Learning Community (PLC). Biology students benefited through attending lessons guided by a few teachers which was totally different from the normal way of teaching and learning. Teachers too learned from each other through PLC to enhance their content knowledge and teaching methods. On top of that, individuals or organisations also reached out to teachers to assist in conducting virtual lesson. Joining hands of individuals and organisations from different levels, students were equipped with the knowledge and skills needed for biology. The limitations in reaching to more learners seemed broken. Further research is needed to develop a better model of virtual classroom and a feasible virtual assessment method. Perhaps, a hybrid form of classroom could be introduced in near future for biology lessons.

Key words: *biology, educational video, pedagogy, Professional Learning Community, teaching and learning*

***Dr. Siew Wai, Kwan**, Email: kwansiewwai@yahoo.com

INTRODUCTION

Due to the lockdown across the world after the striking of COVID-19, many schools were forced to go online overnight in 2020. Everyone from the Ministry of Education, educational Institutions, teachers, students and parents were forced to embrace online teaching and learning without a question (Breslin, 2021). Indirectly, those who were unable to adapt to the condition were "selected out" in the education system (Datamonitor, 2009). This is what educators in Malaysia tried to overcome.

Despite the hectic which COVID-19 created since 2020, it indeed promoted great advancement in teaching and learning (Fiedler *et al.*, 2021). For many years, educators in Malaysia were working together in making lessons accessible by learners (Poon *et al.,* 2004) especially those in rural areas.

For example, some places in Malaysia are less accessible with no well-develop infrastructures. Due to many constraints like location, finance, and facilities, the effort of making lessons accessible to all learners did not seem rewarding as it was planned.

During the COVID-19 pandemic a digital leap pushing all educators and learners to go online and immediately conducting lessons online in various ways (Alakrash and Razak, 2021). The use of social media platforms in teaching and learning seemed dominating the education arena in this period. The urge to form a borderless classroom was raised. Virtual classroom seems catered to the urge.

PROFESSIONAL LEARNING COMMUNITY (PLC) IN ACTION

At the beginning, many problems arise about conducting and attending virtual classrooms. The problems vary from technical to facilities. Hence, the Malaysian Ministry of Education (MOE) initiated a move to call some teachers to work together in producing teaching materials for the virtual classrooms, hoping to make virtual classrooms more accessible and interesting for everyone. One of the ways in overcoming the problems was joining hands of teachers and organisations to conduct the online lessons. Hence, PLC from various levels, for example, MOE level, the Local Education Department level, and school level, simultaneously designed and conducted borderless classroom for Biology students. Soon a collaboration among the educators, parents, government and private sectors emerged during this period to ensure a high quality and accessible education in Malaysia (Wan Mohd Yunus *et al.*, 2021).

Action in MOE level

At the MOE level, activities carried out included enhancing the existing educational TV programmes. The TV programmes were designed according to the syllabus used in the national schools in Malaysia. Teachers were called to conduct lessons in the TV studio and the lessons were broadcasted live on a specific TV channel called DidikTV (initially it was called TV Pendidikan). After the live broadcasting, the lessons were uploaded to YouTube for students and teachers to access on their own paces. The TV programmes reached out to students regardless of location and time. Many students from rural areas benefited from the TV programmes. Figure 1 shows a situation at the studio while doing live broadcasting of a lesson. A few students were selected to follow the lesson, and the teacher was conducting the lesson by interacting with the students. Meanwhile, many more students all over Malaysia could follow the live lesson from YouTube.

Besides enhancing the existing educational TV programmes, MOE also gathered some Biology teachers to develop Biology modules for self-pace learning through PLC. A group of teachers worked together in producing modules for Biology learning and distributed them through social media for the students to do self-pace learning at their own locations. The modules include some notes and worksheets for teachers and students. After the modules were prepared, they were uploaded to Google Drive for the access of other teachers.

Figure 1: Recording at DidikTV studio for Biology subject
Source:https://www.youtube.com/watch?v=9ALkJW-HLbU&t=674s

This development of modules with PLC reduced the workload of teachers in preparing material for the virtual classes. At the same time enabled students from rural areas to conduct self-pace learning with minimal help from teachers. Figure 2 shows examples of the modules developed.

Action in district level

In terms of district level, district education departments called out the biology teachers from each district to conduct online tuition for students within the same district. Hence, teachers from various areas of the district collaborated in conducting online tuition. Figure 3 shows a screen shot of online tuition recorded and uploaded to YouTube. The lessons conducted were broadcasted live, whereas the recording of the lessons was uploaded to YouTube for further reference by teachers and students all over Malaysia.

Action in school level

Meanwhile, some biology teachers from the Kuala Lumpur regions work out another PLC activity. A combined biology class was planned and designed to cater the needs of the students at the Kuala Lumpur regions. Through this combined biology class, teachers from four schools at Kuala Lumpur were collaborating and working together to conduct lessons for their students. Figure 4 shows a screen shot of a lesson being conducted online. The combined class provide opportunities for interactions among teachers and students. This improved the Biology content knowledge and skills among the teachers and students. In addition, the combine class contributed to engaging the teachers in given lessons during the pandemic, at the same time providing a borderless classroom for the students. The effort of having activity like this contributed to the development of teachers' experience in teaching and learning as what reported by Othman *et al.* (2020).

With the PLC collaboration at the ministry, district and school levels, Biology teachers and students were exposed to a borderless platform in knowledge sharing and development. Students and teachers at rural places in Malaysia could access to the materials through the internet or social media and conduct lessons or self-pace learning without actual classes.

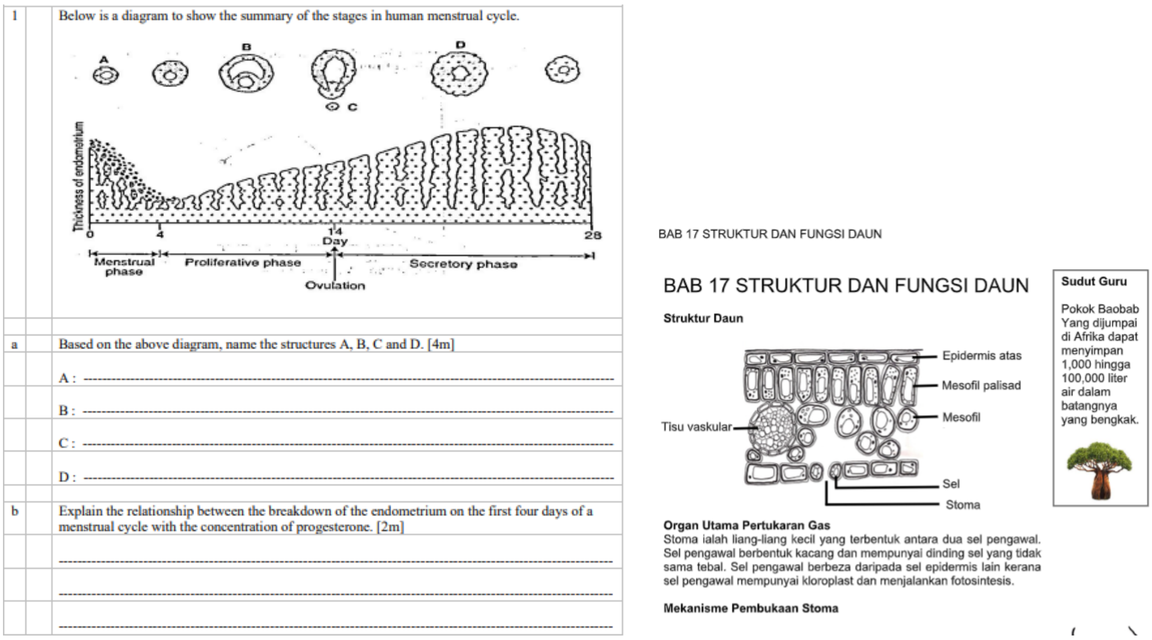

Figure 2: Examples of modules developed for self-pace learning

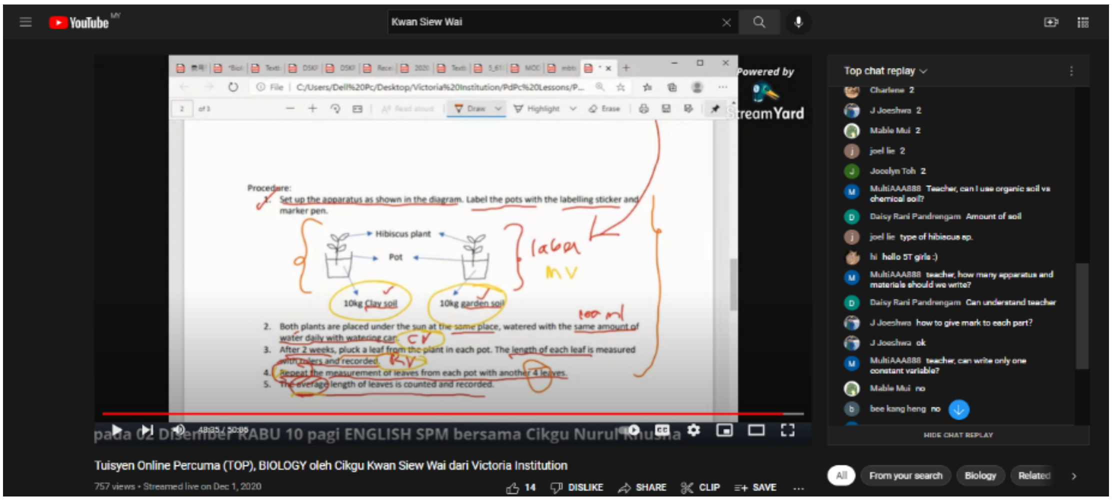

Figure 3: Online tuition for Biology subject organised by a district education department
Source: https://www.youtube.com/watch?v=SPRJpCkN25s&t=2529s

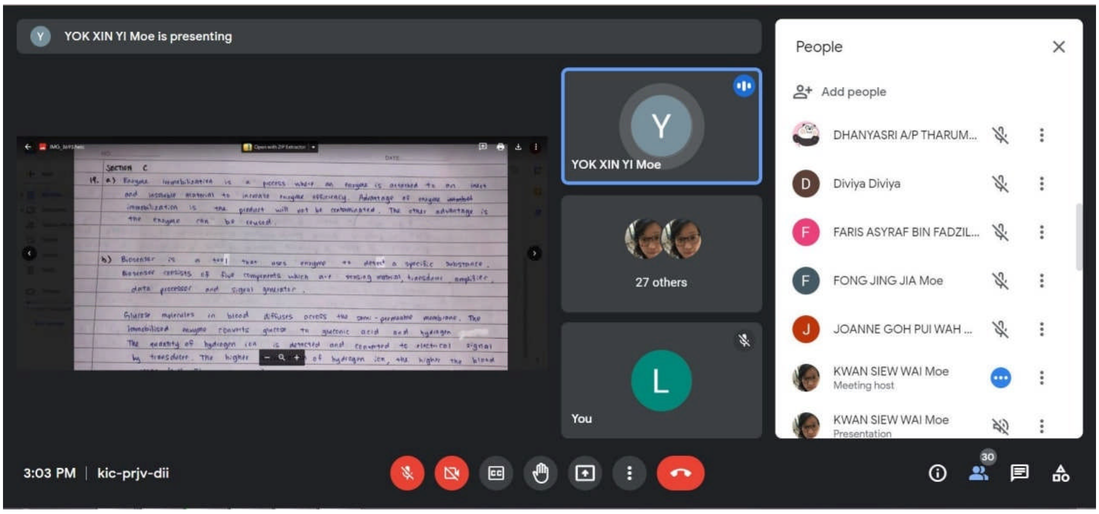

Figure 4: Combined biology class conducted by four teachers from different schools at Kuala Lumpur

CHALLENGES FACED

After two years of virtual classes, there are some challenges faced by teachers and students. For example, teachers and students as yet having a problem in accessing to the virtual classes or an online material due to interrupted internet connection or lack of devices to access to the internet. Similar challenge was also found in the research at Austria (Trültzsh-Wijnen and Trültzsh-Wijnen, 2020). Hence, many parties came in to help overcoming this problem. Government bodies, private companies and religious organisations help in donating mobile phones and laptops for students. Telecommunication companies gave discount to data packages or provide free data for students attending virtual classes. With these helps (from various sectors), virtual classes were commenced successfully to every corner of Malaysia. This was how borderless classroom established in Malaysia. More study of how to improve and enhance the implementation of the virtual classes in the future for better performance is needed.

REFERENCES

Alakrash, H. M., and Razak, N. A. (2021) Education and the fourth industrial revolution: Lessons from COVID-19. *Computers, Materials and Continua* **70**(1): 951–962.

Breslin, T. (2021) *Lesson from Lockdown: The Educational Legacy of COVID-19*. Routledge. https://doi.org/10.4324/9781003121343

Datamonitor (2009) *Malaysia: Country Analysis Report - In-Depth PESTLE Insights, (September)*, pp. 1-81. https://doi.org/10.4324/9781003121343

Fiedler, S. T., Thomas, H.,and Bogner, F. X. (2021) COVID-19 and Lockdown Schooling: How Digital Learning Environments Influence Sematic Structure and Sustainability Knowledge. *Discover Sustainability* **2**: No. 32. https://doi.org/10.1007/s43621-021-00041-y

Hassan, R., Ahmad, J. and Boon, Y. (2019) Instructional leadership practice and professional learning community in the southern zone of Malaysia. *Universal Journal of Educational Research* **7**(12A): 42–50. https://doi.org/10.13189/ujer.2019.071906

Othman, S., Jamian, A. R., Sabil, A. M., Said, R. R. and Omar, R. (2020) Professional learning community (PLC): Approach to enhance students' achievement in language learning at public university, Malaysia. *Universal Journal of Educational Research* **8**(1A), 8–15. https://doi.org/10.13189/ujer.2020.081302

Poon, W. C., Low, K. L. T. and Yong, D. G. F. (2004) A study of Web-based learning (WBL) environment in Malaysia. *International Journal of Educational Management* **18**(6): 374–385. https://doi.org/10.1108/09513540410554031

Trültzsh-Wijnen, C. W. and Trültzsh-Wijnen, S. (2020). *Remote Schooling During The COVID-19 Lockdown in Austria (Spring 2020)*. KiDi-CoTi National Report. https://doi.org/10.25598/KiDiCoTi-AT-2020-1

Wan Mohd Yunus, W. M. A., Badri, S. K. Z., Panatik, S. A. and Mukhtar, F. (2021) The Unprecedented Movement Control Order (Lockdown) and Factors Associated with the Negative Emotional Symptoms, Happiness, and Work-Life Balance of Malaysian University Students during the Coronavirus Disease (COVID-19) Pandemic. *Frontiers in Psychiatry* **11** (February): 566221. https://doi.org/10.3389/fpsyt.2020.566221

Asian Journal of Biology Education, 2023
https://doi.org/10.57443/ajbe.15.0_13

Country Report

Latest Upper Secondary School National Curriculum Standard and Basic Biology Textbooks in Japan

Teiko NAKAMICHI*, Takashi SAIGO, Nobuyasu KATAYAMA
Tokyo Institute of Biology Education, Japan

(Received: 1 July 2022; Accepted for publication: 19 February 2023)

The newly revised Upper Secondary School National Curriculum Standard (USS-NCS) was released by the Ministry of Education, Culture, Sports, Science and Technology, Japan (MEXT), in March 2018, and is being enforced from April 2022. The latest USS-NCS particularly emphasizes proactive, interactive and authentic learning, so called "active learning", so that the students, who study under the regulation of this USS-NCS, will be able to keep up with the development of globalism, technological innovation, and other unknown issues, and survive in an unpredictable society. Therefore, student-centered learning that includes critical thinking, decision-making, presentation and discussion, is emphasized more than teacher-centered teaching. In addition, the latest USS-NCS specifies the number of biological key terms used in textbooks to be around 200 - 250 for Basic Biology and 500 - 600 for Advanced Biology, because MEXT asks biology teachers to shift their focus from cramming in knowledge to developing higher-order thinking skills. Thus, in every revised Basic Biology textbook used from the 2022 school year, the number of key terms is less than 250, and they are presented in some different ways such as in boldface type or in the glossary at the end of the book. Furthermore, these textbooks include several scientific methods to empower students to find questions and problems and solve them on their own. Moreover, there are many exercises that lead student to think deeply. Another feature of these textbooks is that, as part of giving priority to information and communication technology (ICT), QR codes have been incorporated to allow students to learn through the Internet.

Key words: *Active learning, Basic Biology, biological key terms, Japan, National Curriculum Standard, student-centered learning, textbook survey, upper secondary school*

***Mrs. Teiko Nakamichi**, Email: teikonakamichi@hotmail.co.jp

INTRODUCTION

In Japan, since 1947, the National Curriculum Standards (NCSs) for primary and secondary education have been revised about every 10 years (Nakamichi and Katayama, 2018).

In the previous USS-NCS, which was being enforced from 2012, biology-related subjects, in particular, were modernized to reflect the rapid progress in life science research. The number of topics increased and the contents became more challenging particularly in the case of Advanced Biology (Nakamichi and Katayama, 2018). As a result, the number of biological key terms used in both Basic Biology and Advanced Biology textbooks to explain key concepts increased remarkably (Nakamichi, 2017). Therefore, students may have been pressured to memorize these terms to pass semester tests and university entrance exams. MEXT expected teachers to help students acquire "abilities of thinking, judgement, presentation, discussion, etc." through student-centered learning (MEXT, 2012). Thus biology teachers should have shifted their teaching methods to student-centered learning, such as problem-based learning (PBL) (Chin and Chia, 2004; Lambros, 2004) and inquiry-based learning (IBL) (Pedaste *et al.*, 2015) for realizing this idea. But, in our conjecture, many teachers may have persisted in conducting traditional teacher- centered teaching instead of allotting time for inquiry activities including experiments and observations, possibly because they may have felt pressure to help students acquire enough knowledge to pass university entrance exams.

In March 2018, the latest USS-NCS, was released (MEXT, 2018), and is being enforced from April 2022. In the latest USS-NCS, MEXT requires teachers to implement active learning, namely student-centered learning (MEXT, 2015b; MEXT, 2018). University entrance examinations also are going to change in the near feature to remedy a disproportionate emphasis on knowledge (See the Supplemental Note).

In the present paper, we report the features of biology-related subjects in the latest USS-NCS and those of Basic Biology textbooks used currently.

REVISED NATIONAL CURRICULUM STANDARDS

Concepts of Curriculum Design for Latest NCSs

MEXT (2015a) stated the following for revising NCSs: "We must focus on how to face and relate to the accelerating changes in society, including the progress of globalization and ICT. There is an even stronger need for the development of the students' skills required in a complex and rapidly changing society, where the future is difficult to predict, to permeate and materialize into the curriculum of each school and in the teaching of each subject."

Figure 1 (MEXT, 2015b) shows three educational viewpoints to be incorporated into curriculum design from the perspective of "active learning". For making these key concepts manifest, a qualitative improvement of the learning process is requisite to stimulate students' inquiry and problem-solving activities. So, the latest NCS emphasizes "proactive, interactive and authentic learning" (MEXT, 2019) in addition to "thinking, judgement, presentation and discussion" which have already been emphasized in the previous NCS.

Figure 1: Importance of "Active Learning" (MEXT, 2015)

Science Subjects of Latest USS-NCS

As shown in Table 1, in the latest USS-NCS, there are nine elective subjects: four basic subjects, four advanced subjects and Science and Our Daily Life which covers topics of four science areas. Science Project Study which was set up in the previous NCS has been deleted. Advanced subjects are four-credit ones while the others are two-credit ones. Students are rec-

Table 1: Science Subjects for upper secondary school students

Subjects	Science and Our Daily Life	Basic P / C / B / E*	Advanced P / C / B / E*
Credits	2	2	4

* P: physics, C: chemistry, B: biology, E: earth science

ommended to take at least three basic subjects to acquire fundamental scientific knowledge. Alternatively, they can take Science and Our Daily Life and choose one from the basic subjects.

The same as the Lower Secondary School National Curriculum Standard, for which an English translation version (MEXT, 2022) is only available at present, the latest USS-NCS states that the aim of science subjects is "to develop students' competencies necessary to conduct scientific inquiry into natural objects and phenomena, through experiencing natural objects and phenomena, using discipline-based epistemological approaches of science, and conducting observations and experiments with a comprehensive vision " (MEXT, 2018).

A new interdisciplinary subject area, Inquiry-Based Study of Science and Mathematics, has been set up. The aim of this subject area is "to develop students' competencies necessary to find a solution to a given issue by using combined mathematical and scientific interdisciplinary approaches and conducting scientific inquiry through experiencing various objects and phenomena" (MEXT, 2018). As this subject area focuses on nurturing students' mathematical and scientific perspectives and ways of thinking, it may also help to develop internationally competent human resources in the context of changes, such as increasing global competition in scientific research, as well as, in scientific and technological industry. This subject area is composed of two subjects, (i) Basic Inquiry-Based Study of Science and Mathematics and (ii) Inquiry-Based Study of Science and Mathematics.

Aim of Biology-related Subjects in Latest USS- NCS

Following the previous one, the latest USS-NCS pursues modernization in life sciences. Furthermore, it states that biology teachers should guide students in acquiring not only biological concepts, principles and laws, but also the abilities to cope with potential changes in Japanese society when they become adults.

The aim of Basic Biology is "to develop students' competencies necessary to conduct scientific inquiry into organisms and biological phenomena" (MEXT, 2018a). To achieve this aim, biology teachers are asked "to ensure that students experience organisms and biological phenomena, using scientific epistemological approaches, and conducting observations and experiments with a comprehensive vision. Specifically, students must:

(1) Understand organisms and biological phenomena in relation to daily life and society, and acquire fundamental skills for observations, experiments, and other scientific activities necessary to conduct scientific inquiry into organisms and biological phenomena;
(2) Develop abilities to conduct scientific inquiry through conducting observations, experiments, and other scientific activities;
(3) Develop attitudes toward conducting scientific inquiry through actively experiencing organisms and biological phenomena, toward respecting for life and contributing the conservation of natural environments" (MEXT, 2018).

The aim of Advanced Biology is almost the same as that of Basic Biology except for item (1), *i.e.*, "(1) Deepen knowledge and understanding of fundamental biological concepts, principles and theories, as well as natural objects and phenomena, and acquire fundamental skills for observations, experiments, and other scientific activities necessary to conduct scientific inquiry into organisms and biological phenomena" (MEXT, 2018).

MEXT also asks biology teachers to shift their focus from the cramming in of knowledge to the development of students' higher-order thinking skills. To achieve this objective, the latest

USS-NCS requires that the number of biological key terms used in biology textbooks be reduced to around 200-250 for Basic Biology and 500 – 600 for Advanced Biology (MEXT, 2018).

Contents of Basic Biology and Advanced Biology in Latest USS-NCS

In Basic Biology, there are three units, namely, Characteristics of Organisms, Regulation of Human Body, and Diversity of Organisms and Ecosystems. Each of these units is composed of two sub-units and each sub-unit is composed of one or two topics (Table 2).

In Advanced Biology, there are five units, namely, Evolution, Life Phenomena and Substances, Gene Expression and Ontogeny, Responses to Environmental Stimuli, and Community and Its Environment. Each of these units is composed of two or three sub-units and each sub-unit is composed of one or two topics (Table 3). A prominent feature is that evolution must be taught first. Until now, evolution and phylogeny have been the last units to be taught.

Table 2: Contents of Basic Biology

Major units	Sub-units	Topics
Characteristics of Organisms	1. Characteristics of Organisms 2. Genes and Their Function	1.1 Unity and Diversity of Organisms 1.2 Organisms and Their Energy 2.1 Genetic Information and DNA 2.2 Genetic Information and Protein Synthesis
Regulation of Human Body	1. Regulations by Nervous and Endocrine Systems 2. Immunity	1.1 Transmission Mechanism 1.2 Maintenance Mechanism of Internal Environment 2.1 Immunity mechanism
Diversity of Organisms and Ecosystems	1. Vegetation and Succession 2. Ecosystems and Their Conservation	1.1 Vegetation and Succession 2.1 Ecosystems and Diversity of Organisms 2.2 Balance in Ecosystems and their Conservation

Table 3: Contents of Advanced Biology

Major units	Sub-units	Topics
Evolution	1. Origin of Life and Evolution of Cells 2. Alteration of Genes and Mechanism of Evolution 3. Phylogeny and Evolution of Organisms	1.1 Origin of Life and Evolution of Cells 2.1 Alteration of Genes 2.2 Changes in Gene Combination 3.1 Phylogeny and Evolution of Organisms 3.2 Phylogeny and Evolution of Humans
Life Phenomena and Substances	1. Cells and Biomolecules 2. Metabolic Activities	1.1 Biomolecules and Their functions in Cells 1.2 Roles of Proteins in Life Phenomena 2.1 Respiration 2.2 Photosynthesis
Gene Expression and Ontogeny	1. Genetic Information and Its Expression 2. Ontogeny and Gene Expression 3. Genetic Engineering	1.1 Genetic Information and Its Expression 2.1 Regulation of Gene Expression 2.2 Ontogeny and Gene Expression 3.1 Genetic Engineering
Responses to Environmental Stimuli	1. Responses of Animal and Its Behavior 2. Responses of Plant to Environmental Stimuli	1.1 Reception of Stimuli and Reactions 1.2 Animal Behavior 2.1 Responses of Plants to Environmental Stimuli
Community and Its Environment	1. Population and Community 2. Ecosystems	1.1 Population 1.2 Community 2.1 Matter Production and Cycle of Matter in an Ecosystem 2.2 Ecosystems and Human Life

FEATURES OF LATEST BASIC BIOLOGY TEXTBOOKS

We surveyed latest Basic Biology textbooks to be used from the 2022 school year to find how the contents of these textbooks have changed. Five publishers respectively publish two or three different versions of Basic Biology textbooks. We randomly chose one from each publisher's textbooks.

Exercises and Examples of Research Methods

Basic Biology textbooks include more exercises for inquiry activities that allow students to think deeply than before.

Figure 2 shows the first page of the chapter "Diversity and Unity of Organisms" in a Basic Biology textbook. In this textbook, at the beginning of each section of each chapter, there is a simple exercise named "Let's Start." The purpose of this exercise is to allow students to generate questions related to the contents of each section before they start learning. The exercise of Let's Start for this section, Diversity of Organisms, includes the question, "Approximately how many kinds of organisms are there on the earth?" (Figure 2, A) At the bottom, there is another question, "Why are there so many diverse species on the earth?" (Figure 2, B) This is designed to get students to think about what they are learning in this section.

Figure 3 shows the first two pages of the same topic in another textbook. In this textbook, there is an introductory question (Quest), "How are the body structures and lifestyles of the mammals in the figure suitable for their environment?" (Figure 3, A) This question may lead students to consider possible answers before studying the contents of the chapter. There also is an exercise that instructs students to "Give specific examples of organisms other than mammals that have forms and functions suitable for their environments." (Figure 3, B) This exercise aims

Figure 2: The first page of the chapter "Diversity and Unity of Organisms" in a Basic Biology textbook of Tokyo Shoseki Co. Ltd.

There are two exercises (questions) A and B (see text in detail).

at encouraging students to think more deeply.

Furthermore, each textbook provides many examples of research methods to empower the students to find questions and problems and to solve them on their own.

Promotion of ICT

As part of giving priority to ICT, all Basic Biology textbooks incorporate QR codes. The QR codes allow students to learn by themselves through the Internet and deepen their thinking independently. There are a variety of websites or webpages the QR codes link to, for example, a QR code in the section "Diversity and Unity of Organisms" links to a webpage on which a short movie about the environments of various mammals and their behaviors is provided. Another example is on a page with a section titled, "Genetic Information and DNA". This links to a webpage of DNA models where students can

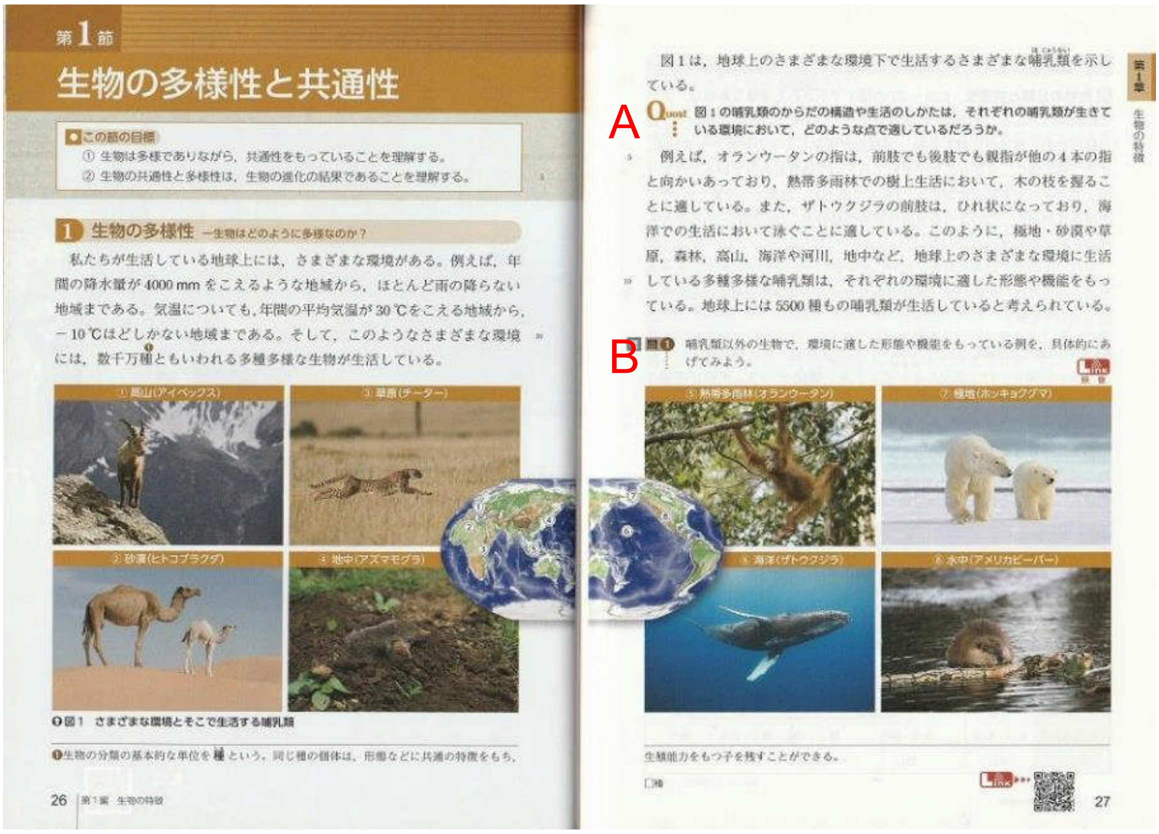

Figure 3: The first two pages of the chapter "Diversity and Unity of Organisms" in a Basic Biology textbook of Suken Shuppan Co. Ltd.
There are two exercises (questions) A and B (see text in detail).

visually comprehend the three-dimensional DNA structure by moving the DNA models on the computer display.

The number of QR codes is quite different among the textbooks surveyed. As an example, the number of QR codes in the section "Genetic Information and DNA" in each textbook, is given in Table 4. In the case of publisher J, there is only one QR code on the index page of the textbook. The QR code links to the index page of a website with seven titles. By clicking on one of these titles, the user can watch a movie with corresponding content. On the other hand, in the case of publisher K, there are 23 QR codes which link to 59 movies, 41 of which are lectures given by tutors. In the cases of publishers J and T, some QR codes link to "NHK for School," a website of video clips supplied by the Japan Broadcasting Corporation (NHK, see the website list).

Table 4: QR code-linked contents in the Chapter Genetic Information and DNA of each textbook

Publisher*	No of QR codes	No of con-tents	Approx. time (min) required for watching all contents
D	8	13	26
J	1	7	8
K	23	59	117
S	11	20	31
T	8	11	7

* D: Dai-ichi Gakushusha Co. Ltd., J: Jikkyo Shuppan Co. Ltd., K: Shinkoshuppansha Keirinkan Co. Ltd., S: Suken Shuppan Co. Ltd., T: Tokyo Shoseki Co. Ltd.

Previously, teachers showed movies to the students all at the same time in their classrooms. By using QR codes, students can access these programs by themselves and study independently. They also can use QR codes to get materials for group discussion. From now on, it will be necessary for teachers to instruct students how to learn through the Internet, how to get programs other than those to which the QR codes refer, and how to use these programs and materials for their study. On the other hand, teachers should be careful that students do not become excessively dependent on the Internet, because hands-on experience and interactive learning are also encouraged (MEXT, 2012; MEXT, 2018).

Biological Key Terms

The number of biological key terms in previous Basic Biology textbooks averaged about 450 each (Nakamichi, 2017). The latest USS-NCS requires a reduction of the number of biological key terms used in Basic Biology textbooks to be around 200-250 (MEXT, 2018). Table 5 shows the number of key terms in each textbook which is almost within the range indicated by the USS-NCS.

Table 5: Number of biological key terms in Basic Biology textbooks

	Publisher*				
	D	J	K	S	T
No. of key terms	222	190	249	253	218

* D: Dai-ichi Gakushusha Co. Ltd., J: Jikkyo Shuppan Co. Ltd., K: Shinkoshuppansha Keirinkan Co. Ltd., S: Suken Shuppan Co. Ltd., T: Tokyo Shoseki Co. Ltd.

These key terms in each textbook are shown in different ways (Table 6). In the text, if key terms are shown in boldface, students may easily notice them. In addition, some textbooks arrange the key terms in orders of higher, middle and lower concepts. This is more effective than just listing the terms in Japanese alphabetical order in the glossary at the end of the book.

Table 6: How biological key terms are shown in Basic Biology textbooks

Publisher*	Manner of key term display
D	Key terms are shown in boldface in the text.
J	Key terms are shown in a yellow-colored box on every page where they appear in the text. At the same time, key terms are compiled in the glossary together with the other terms and arranged in Japanese alphabetical order. Key terms are indicated in red.
K	Key terms are shown in a yellow-colored box on every page where they appear in the text.
S	Key terms are compiled in the glossary and arranged in the order (higher, middle, and lower) of concepts.
T	Key terms are compiled in the glossary and arranged in Japanese alphabetical order.

* D: Dai-ichi Gakushusha Co. Ltd., J: Jikkyo Shuppan Co. Ltd., K: Shinkoshuppansha Keirinkan Co. Ltd., S: Suken Shuppan Co. Ltd., T: Tokyo Shoseki Co. Ltd.

SUPPLEMENTAL NOTE

REFORM OF UNIVERSITY ENTRANCE EXAMINATION SYSTEM

As mentioned above, biology education at the upper secondary level has been considerably affected by university entrance examinations. Therefore, to realize the concepts of the latest USS-NCS, the university entrance examination system should also be reformed.

From 1979 to 1989, the Joint First-Stage Achievement Test was conducted by the National Center for University Entrance Examinations (NCUEE) every January for admissions to national and local public universities. Then, it was replaced by the National Center Test, which was also conducted by NCUEE from 1990 to 2020 for admissions to national, local public and private universities (NCUEE, 2022). The number of private universities which use this test instead of their own entrance examination has been increasing year by year. Recently, based on a report of the Central Council for Education, 2014, the implementation guidelines and the contents of the National Center Test were revised (MEXT, 2021) and the new test framework, *i.e.*, the Common Test for University Admissions (CTUA), has been implemented from January 2021 (NCUEE, 2022). More than earlier versions, the CTUA requires critical thinking skills. Conversely, questions that simply examine candidates' knowledge have been decreased. In addition to this, the admission scheme of universities has become more diverse. Through the integration of CTUA and respective university examinations, the individuality and diversification of the admissions systems by universities have been promoted. Some examples of university admission schemes are shown in NCUEE's document (NCUEE, 2022).

Thus, a variety of entrance examination methods are being introduced. A remarkable feature of current university admissions is a shift from simple knowledge-based examinations to examinations or screening that can evaluate students' diverse abilities. As a result, there may be a substantial difference in the achievement among enrolled students. To keep students from experiencing difficulties due to gaps between their studies in secondary schools and in universities, collaboration between upper secondary schools and universities continues to progress. (Kawai, 2018; MEXT, 2021).

REFERENCES

Chin, C. and Chia, L. G. (2004) Implementing project work in biology through problem-based learning. *Journal of Biological Education* **38**(2): 69-75. https://doi.org/10.1080/00219266.2004.9655904

Kawai, H. (2018) Transitions and future prospects of linking secondary and higher education in Japan: Toward education valuing more independent thinking. *The Journal of Economic Education* **37**: 20-26. (in Japanese) https://www.jstage.jst.go.jp/article/ecoedu/37/37/37_20/_pdf/-char/ja

Lambros, M. A. (2004) *Problem-Based Learning in Middle and High School Classrooms: A Teacher's Guide to Implementation*. Corwin Press, CA, USA.

Ministry of Education, Culture, Sports, Science and Technology, Japan (2012) *Examples of Images of Classroom Improvement through Language Activities.* (in Japanese) https://www.mext.go.jp/component/a_menu/education/micro_detail/__icsFiles/afieldfile/2012/07/04/1322425_02.pdf <Accessed, December 27, 2022>

Ministry of Education, Culture, Sports, Science and Technology, Japan (2015a) *Summary of the Issues Discussed in the Special Subcommittee on National Curriculum Standards Planning* (in Japanese) https://www.mext.go.jp/component/b_menu/shingi/toushin/__icsFiles/afieldfile/2015/12/11/1361110.pdf <Accessed, December 27, 2022 >

Ministry of Education, Culture, Sports, Science and Technology, Japan (2015b) *Reference Material 1: Second Japan-OECD Policy Dialogue Report on Education towards 2030.* (in Japanese) https://www.mext.go.jp/b_menu/shingi/chukyo/chukyo3/053/siryo/__icsFiles/afieldfile/2015/08/04/1360597_6_1.pdf <Accessed, December 27, 2022 >

Ministry of Education, Culture, Sports, Science and Technology, Japan (2018) *The Upper Secondary School National Curriculum Standard*. (in Japanese) https://www.mext.go.jp/content/20230120-mxt_kyoiku02-100002604_03.pdf <Accessed, February 17, 2023 >

Ministry of Education, Culture, Sports, Science and Technology, Japan (2019) *Overview of the Ministry of Education, Culture, Sports, Science and Technology*. https://www.mext.go.jp/en/about/pablication/_icsFiles/afieldfile/2019/03/13/1374478_001.pdf <Accessed, December 27, 2022 >

Ministry of Education, Culture, Sports, Science and Technology, Japan (2021) *Reference Material 2-2: Basic Materials Related to the Selection of University Entrants, Vol. 2 - Related to the Progress of the Upper Secondary School-University Connection Reform, etc.* (in Japanese) https://www.mext.go.jp/content/20210707-mxt_daigakuc02-000016687_3.pdf <Accessed, December 27, 2022 >

Ministry of Education, Culture, Sports, Science and Technology, Japan (2022) *The Lower Secondary School National Curriculum Standard, Chapter 2, Section 4 Science (A Tentative Version of English Translation).* https://www.mext.go.jp/content/20220405-mxt_kyoiku02-000005242_003.pdf <Accessed, December 27, 2022 >

Nakamichi, T. (2017) Comparison of terms appearing in and the number of pages of the revised "Basic Biology" textbooks with the first version. *Japanese Journal of Biological Education* **59**(1): 19–25. (in Japanese) https://doi.org/10.24718/jjbe.59.1_19

Nakamichi, T. and Katayama, N. (2018) Biology education in upper secondary schools at present in Japan. *Asian Journal of Biology Education* **10**: 7-16. https://doi.org/10.57443/ajbe.10.0_7

National Center for University Entrance Examinations (2022) *National Center for University Entrance Examinations, 2022 Fiscal Year (A Tentative Version of English Translation).* https://www.dnc.ac.jp/albums/abm.php?d=18&f=abm00003230.pdf <Accessed, December 27, 2022 >

Pedaste, M., Mäeots, M., Siiman, L. A., Jong, T., van Riesen, S. A. N., Kamp, E. T. Manoli, C. C., Zacharia, Z. C. and Tsourlidaki, E. (2015) Phases of inquiry-based learning: Definitions and the inquiry cycle. *Educational Research Review* **14**: 47-61. https://doi.org/10.1016/j.edurev.2015.02.003

WEBSITE

Japan Broadcasting Corporation: *NHK for School* https://www.nhk.or.jp/school/ <Accessed, November 03, 2022 >

Asian Journal of Biology Education, 2023
https://doi.org/10.57443/ajbe.15.0_22

Country Report

Nature Study in Australia – Past, Present and a Desirable Future

Robert WALLIS*
Federation University, Australia

(Received: 14 February 2023; Accepted for publication: 19 February 2023)

Natural history has been important in western civilization since Aristotle published the *History of Animals* in the 4th Century until modern times through the extraordinary popularity of naturalist Sir David Attenborough's books, television series and films. Despite natural history having laid the foundation for many advances in biology, Nature study in Australian schools has been in decline after once playing an important role, especially in the curriculum of elementary schools. Nature study and its accompanying field work is now less common in the crowded curriculum which must accommodate considerable laboratory and 'inside' work, reflecting the multiple sub-disciplines that now constitute biology. A future is envisioned where the value of study of nature is re-invigorated; one that will better prepare citizens for a world in which there are serious environmental challenges, especially in terms of loss of biodiversity and climate change.

Key words: *Australia, field work, natural history, nature study*

***Robert Wallis**, Email: r.wallis@federation.edu.au

INTRODUCTION

Natural history is the study and documented recording of nature, usually by adults. In contrast, Nature study is here taken to mean the study of nature in schools. Field work is an integral component of both Nature study and natural history.

Natural history as a systematic study dates back to the Ancient Greeks, documented in Aristotle's pioneering observations of animals in his *History of Animals* in the 4th Century BC (see Balme, 1991). It progressed through the Renaissance and Enlightenment eras to the 19th Century exemplified in Charles Darwin's revolutionary naturalist contribution to evolutionary biology in his *Origin of Species* published in 1859. In today's times Sir David Attenborough has globally popularised natural history with over 98 popular natural history documentaries such as *Life on Earth* broadcasted in1979 (BBC, 2023 – see Websites list that attracted an estimated 500 million viewers alone (Wikipedia, 2022 – see Websites list). More recently a single episode of Planet Earth II broadcast in 2016 attracted 1.8 million viewers in the 16 – 35 years age bracket (BBC, 2022 – see Websites list).

Remarkable strides in biological knowledge have been achieved over many centuries which have relied on naturalist knowledge as the foundation for generation of broader transdisciplinary biological and ecological breakthroughs. Why then does Nature study appear to be valued less in the 21st C education school curricula in Australia than previously? Given Australia's rich and unique biodiversity status as one of only 12 megadiverse countries in the world (Iberdrola, 2023 – see Websites list), should Australia be complacent in educating the next generation to understand and most importantly *value* the natural environment?

Nature study typically involves field work where school students immerse themselves in nature, not only acquiring knowledge about the natural world, but often developing an empathy with nature that results in their supporting conservation and other environmental causes. Nature study has existed in school curricula in Australia since the States federated in 1901. While it often involved in-classroom work such as dissection of flowers, readings from books and teachers' lectures, there has been an encouragement for outdoor work that formed the basis for field studies as well as exemplifying the more progressive practices in education at the time.

Here I review Nature study in Australian (mainly Victorian) schools from when it became established into new syllabi in 1902, through to the decline in modern era, and then provide an envisioned future.

Why study nature?

Nature study involves careful observation, an enquiring mind and an aesthetic appreciation of and understanding about the natural world. It can also develop empathy by students *for* the environment. Given the environmental challenges we face today, it is important we develop a pro-active, knowledgeable citizenry who are concerned about environmental degradation and loss of biodiversity. Furthermore, Nature study can lead children in their later lives to become naturalists who will be able to provide experimental ecologists with the keen observations and raw data that their models, hypotheses and experiments require (Noss, 1996). Kitano (2004) reported the study of nature encourages students to learn outdoors in the field and there is emerging evidence this can have significant mental and physical health benefits (Ayotte-Beaudet and Berrigan, 2022 – see Websites list; Mann *et al.*, 2022).

NATURE STUDIES IN AUSTRALIAN SCHOOL CURRICULA

The beginning

Australia was settled by the British in the late 18th Century and the Colony of Port Phillip (later to become the State of Victoria) in the early 19th Century. Federation of the colonies occurred in 1901 to form the Commonwealth of Australia.

In the 1800s the view of Australian nature was that it be subdued and exploited and changed to reflect that of England (Kass, 2014a; Price, 2019). For example, the Victorian Acclimatization Society was established in 1861 to introduce flora and fauna (especially game birds and mammals) from 'home' to Australia. The consequences of these introductions were unforeseen, "there was never a body of men so foolishly, so vigorously, and so disastrously wrong" (Rolls 1984, p. 210). The legacy today is severe and deleterious impacts on the environment from major introduced pests such as rabbits, European carp and various deer species (Tout-Smith, 2003 – see Websites list).

A comparable imperial view was reflected in the school curriculum that "inculcated respect for British society's hierarchical order based on fixed lines of race, class and gender" (Price, 2019, p. 119). The *Irish National Readers* formed the basis of the Victorian school curriculum from 1851 to 1877. These texts were graded for different age levels and, while deemed pedagogically sound, included many Bible stories and tales about European domestic and wild mammals (Price, 2019).

In 1861, the *Irish National Readers* were revised in Great Britain in response to criticisms about their content and how poorly they were graded. Subsequently Victoria adopted a revised curriculum with some minor adaptations to an Australian context in 1871. Many Australian educators and the public began to query the relevance of the revised Readers, especially their Irish context and frequent reference to religion. There was an emerging recognition of Australian literature, art and nature, and thus a move to discard the Irish Readers from the State's curriculum; replaced by another set of readers from Ireland called the *Royal Readers* in 1877, which still referred extensively to British animals and plants with few Australian references. Those that did mention Australia were rather disparaging. For example, the Australian biota was "strange and unlike those of other countries", Aboriginals were "a very wild and savage race" and it "is a pretty sight to see wild rabbits running over the fields" (quotes from *The Royal Readers II and III* cited by Price, 2019).

Concern for relevant nature content in the education syllabus during the mid to late 1800s reflected the emerging interest in Australian nature by the wider community in general. In 1874, for example, the Linnaean Society of New South Wales (see Websites list) was established to "promote the Cultivation and Study of the Science of Natural History in all its branches" and the Society has published its Proceedings since 1875. In 1880, the Field Naturalists Club of Victoria (FNCV) was formed with the joint aims of studying and preserving nature; its highly regarded journal *The Victorian Naturalist* was first published in 1884. The FNCV held monthly meetings at which members gave presentations and displayed items of interest. Regular field trips were held. Some of the most popular activities with the public were the Club's annual conversaziones (public illustrated lectures); in 1889 over 700 people attended (Presland, 2016). Wildflower shows were held annually from 1881 in conjunction with the conversazione, with ordinary meetings or larger exhibitions arranged by other organisations. Subsequent shows included other natural history exhibits besides flowers which also proved extremely popular with the public. The FNCV continues today with a strong membership, a journal published every two months, nine special interest groups and with regular meetings and field trips. Importantly, one of the groups is set up for children.

Despite the increased interest in Australian natural history (and Australian history, literature and art), *The School Paper,* introduced in 1896 to replace *Royal Readers* in Victoria, still reflected Australia's British colonization and remained the mandatory reading material in Victorian elementary schools (called primary schools in Australia) until deemed obsolete 72 years later in 1968. Its' founding editor argued *The School Paper* aimed to acquaint children with the great prose and poetic works of our literature, acquaint them with classic stories of the ages, and develop in them an understanding love of Victoria, of Australia, of the British Empire, and through these, of humanity (Price, 2019). Most importantly, *The School Paper* also aimed to develop a love of nature in students.

New Education Movement

The New Education Movement, also known as Progressive Education, emerged through several initiatives in Europe and the USA late in the 19th Century (Kass, 2014a; Haenggeli-Jenni, 2020 – see Websites list). It placed the student (as opposed to the teacher) at the centre and incorporated scientific research findings from psychology, anthropology and biology. The teaching focused on student experiential and experimental learning and included topics such as Nature study, agriculture, woodwork, sewing and moral education, as well as more traditional academic subjects. From 1891 a series of important Nature study schoolbooks were produced in the USA (Jackman, 1891; Scott, 1901; Bailey, 1903) that Kass (2014b) believes had a major influence on Australian elementary school curricula.

The emergence of Nature study in Australian schools thus reflected many of the aspects of New Education. In Victoria, Frank Tate, then Director of Education, enthusiastically embraced the benefits of Nature study in his introduction to the textbook by Gillies and Hall (1903). In doing so, Tate quoted from Charles Hodge's earlier (1859) book:

> "Nature study is learning those things in Nature that are best worth knowing, to the end of doing those things that make life worth living. …. as soon as this truth began to influence educational practice, as soon as teachers began to feel the unreality and dead formalism of so much of school education, there should have arisen the cry – Back to natural methods! Back to the study of Nature herself!". (Tate, 1903, p. ix).

And later,

> "Nature study answers satisfactorily to every test the educator may apply. Are we concerned with the intellectual aspect of mental training chiefly, then no subject can give more interesting and effective exercise in close and sustained observation, in comparison and generalization, in collecting and systematizing truths, and in working out the causes and results of observed facts. But best of all, no subject satisfies so thoroughly the emotional and aesthetic necessities so strong in the child's nature…" (Tate, 1903, p. x).

The obituary for Tate noted:

> "He has been responsible for so many reforms and developments that one can only give a survey of his major achievements. He aimed to make the school a happy place an efficient instrument for the training of the young in citizenship and an integral part of the community in which it was situated. …. In the early 20th Century Mr. Tate advocated education as opposed to instruction - in other words development of the mind instead of cramming it with more or less useless facts. He believed that pupils should be taught to think and to reason to read and to comprehend to listen and to understand. The schoolroom and the school surroundings should be made as beautiful as possible. Every school should take an interest in beautifying its grounds and improving the waste lands of the community. This idea led to the Schools Endowment Plantation scheme by which pupils were encouraged to plant waste areas with trees and to teach the community that trees were worthwhile and necessary." (Seitz, 1939, p. 10).

Tate was commended for his strong support for Nature study when its introduction was met with derision by some educators who considered it a "frill" or a "fad" (Leach, 1929). Nature study thus not only taught students *about* nature and the environment, it also stressed learning occurring *in* the environment and importantly *for* the environment.

Western Australia was the first Australian state to reform its elementary school curriculum in light of the New Education movement from 1896, but Kass (2014a) notes that Nature study was treated in the curriculum as a means of economic development by emphasizing the importance of agriculture and rural education. Nature study was introduced later into the Victorian elementary schools in 1902 and two years later in New South

Wales where it was placed in order of importance only behind English and Mathematics (Kass, 2014a, 2018). The other Australian states followed soon after, although each state had its own version of the new curriculum for elementary school students.

In addition to *The School Paper*, other significant texts and resources were produced to provide student learning materials in Nature study (Gillies and Hall, 1903; Gillies, 1904a, b; Long, 1905; Leach, 1929). Kass (2018) highlighted an important article published by Hamilton (1904) that directed teachers to authoritative texts, discussed methodologies and gave practical suggestions for teaching the subject in New South Wales schools. Hamilton's article was published before the Victorian Charles Long's lecture *The Aim and Method in Nature Study* was given and published in 1905. Leach (1929) included an appendix that not only provided notes on the aims, principles and methods of Nature study, but many practical suggestions for teachers that followed on from his earlier guides for teachers (Leach, 1905, 1909).

There is no doubt Nature study in elementary schools had a major impact on students' knowledge about and attitude to nature, but the extent of this impact surely depended on the teacher and their school's support for the subject. My personal recollection of Nature study in elementary school in the 1950s was that we studied nature in the classroom with virtually no field work, reading from *The School Paper*, listening to radio broadcasts from well-known naturalist, Phillip Crosbie Morrison, and being a member of a national bird conservation group known as the Gould League of Bird Lovers. The experience of other students was much more fulfilling (Price, 2019).

Nature study in the current curriculum

From the 1950s Nature study in Australian schools has evolved into various forms, from natural science, through to science, then to environmental education and now in components of education for sustainability. A criticism of Nature study has been its failure to be sufficiently scientific. This criticism in Australian schools was championed by teacher educator Thistle Harris who, as early as 1945 urged science be taught in elementary schools that

- avoided animistic and mystical explanations of the natural world
- downplayed purely observational activities
- avoided developing an appreciation of or sympathy with nature
- encouraged proper scientific investigation (Kass, 2014a).

Harris produced two books for elementary science teachers – one for New South Wales (Harris 1945a) and the other for Victoria (Harris 1954). She also wrote resource books on natural history for adults (Harris, 1945b) and Nature study for children (Harris, 1945c).

Today, a national Australian curriculum is adapted by the states as it is they who have legislative responsibilities for school education. In Victoria, the Victorian Curriculum and Assessment Authority (VCAA) designs and oversees implementation of the preparatory level to year 10 (F – 10) high school curricula for compulsory school levels in eight study areas (subjects), of which science is one. The program levels are meant to reflect learning achievements rather than actual school levels and are grouped into three categories:

- Foundation stage (Prep to grade 2)
- Breadth stage (3 – 8)
- Pathways stage (9 – 10).

There are also four pre-Foundations levels A to D for students with special needs.

The VCAA also has responsibility for senior secondary school (years 11 – 12) curricula in which students complete a Victorian Certificate of Education (VCE). Major reforms of the VCE have been announced, that will be fully implemented by 2025.

Details of these curricula can be found in the VCAA Web site (VCAA (a-d) – see Websites list).

So, what elements of Nature study are still taught in Victorian schools? Up to level 10, Nature study is covered in the study area of Science. Two themes permeate through the curriculum – Science Understanding and Science as Inquiry. In the seven stated aims of the Science study area, the terms "aesthetics," "sympathy" and "appreciation" (in terms of nature) are not found. The components of the curriculum relevant to nature are listed in Table 1 (at the end of this paper).

In the VCE, two science subjects have relevance to nature study: Biology and Environmental Science. Tables 2 and 3 (at the end of this paper) document the very limited time devoted to what might be traditionally called Nature study. As with the F – 10 programs, there is no mention of appreciation, empathy or sympathy with nature or aesthetic beauty of nature. A subject in the study area of the humanities is Outdoor and Environmental Studies (VCAA, 2016) that emphasizes humans' uses of outdoor environments (Table 4: at the end of this paper). This subject clearly exemplifies many of the aspects covered in traditional Nature study, but the enrolments are low (Table 5). In Victoria, students typically take five subjects in their final year of high school, with English the only compulsory one. However, areas covered in Outdoor and Environmental Studies include field work, observing and recording nature, ecology, environmental degradation, conflicts in environmental processes and health benefits of nature.

But what of adults interested in nature – the naturalists who pursue natural history?

In an early issue of the prestigious journal *Conservation Biology*, editor Reed Noss decried the decline in natural history and field work. He claimed it was so much easier for biologists to become "keyboard" ecologists, tied to their computers and models than undertaking the laborious and tedious field work that is so important in providing the significant observations and primary data for experimental biologists. Grants to collect observational data outdoors are hard to obtain. Earlier, Evans (1985) had noted that natural history had the insulting descriptor of "alpha ecology" as it is thought by many to have little or no potential for generating ideas. Noss (1996, p. 2) argued we are becoming increasingly separated from nature. He stated

> "One of our [conservation biologists] most crucial roles in society is as spokespersons for Nature. ….We are asked…for our professional opinions on which conditions will favour the conservation of biodiversity… and which will not. What will we look to for help in answering these difficult questions? Our computer models?

Table 5: Student enrolments in Unit 4 (final year of high school) for relevant subjects mentioned in the text*

Subject	Unit 4 enrolment 2021
English	45,660
Biology	15,028
Outdoor & Environmental Studies	2,563
Environmental Science	1,206

*Source: https://www.acara.edu.au/reporting/national-report-on-schooling-in-australia/year-12-subject-enrolments <accessed: 18/02/2023>

Our GIS software? The World Wide Web? Yes, in part. But if we apply these tools in the absence of a firm foundation in field experience, void of the 'naturalist's intuition' that is gained only by many years of immersion in raw Nature and through ceaseless hunger for knowledge about living things, we are sure to go astray."

Such a sentiment was also expressed in Victoria when the FNCV's journal *The Victorian Naturalist* was threatened with closure (Larkin, 1970). Fortunately, it stayed the course and continued to publish natural history and descriptive ecological studies and with the advent of electronic publishing, no longer faces the huge costs incurred in purely hard copy journal production.

Why has Nature study declined in schools?

The decline in Nature study, field work, natural history and development of a love of nature has many causes:

- Nature study is considered too unscientific; Natural history is looked down upon by practicing, experimental ecologists. Given the challenges humanity faces in climate change, biodiversity loss, pollution and environmental degradation, these studies should be considered highly with suitable funding to support field work.
- The school curriculum is too crowded. There are so many competing calls on student time that nature study and its high time commitment loses out. Even Biology has many competing sub-disciplines that squeeze descriptive ecology from the curriculum. For example, there seems to have been a shift from understanding the fundamental nature of form and function in the traditional sciences to scientific and technical literacy – inquiry, exploration and experimentation.
- Workplace safety "red tape" makes it too difficult to take students into the field. Safety forms must be completed, parental approval obtained, safe operating procedures followed, timetables switched – these factors make outdoor studies difficult.

An envisioned future

I am sure there are other arguments. But given the seriousness of the environmental problems we face, then surely it is imperative we revert to a school curriculum that supports teaching *about*, *in* and *for* nature? A future is envisioned in which school students are immersed in the natural environment and encouraged to explore and observe its intricacies. As the students progress, they apply a scientific framework to their astute observations about nature. As for adult learners, their studies in Biology and Environmental Studies lead to the foundations of natural history being incorporated into curricula as bases for experimental studies. Universities will stop insisting academics only publish in the highest category of prestigious journals and encourage staff to write for a wider, lay audience who read natural history publications and "lower-status" journals. Government and industry should support funding for teaching and research in field work that develops foundation knowledge based on meticulous and significant observation and provides the source information for policy decisions.

CONCLUSION

The view of nature in Australian education has undergone many changes. Post European settlement, nature was a set of resources to be exploited and dominated, and studies reflected the British heritage. Acclimatization societies flourished as European settlers yearned for an environment that reminded them of home.

The New Education movement that swept Europe and the United States in the late 19th Century saw a transformation in the elementary school curriculum towards self-directed, experiential learning in the natural environment. Students were encouraged to appreciate nature's aesthetic beauty and develop an empathy for nature through compulsory Nature studies programs introduced in the early 20th Century. By the 1960s interest in the descriptive aspects of Nature studies was replaced by a more inductive, scientific approach resulting in Nature studies being taken over by subjects such as Natural Science, Biology and Environmental Studies.

In Victorian senior high schools, the only subject that reflects the philosophy and tenets of Nature study is Outdoor and Environmental Studies, a subject that is grouped with humanities subjects and not science.

A future is envisioned in which student immersion in nature is returned, respected and valued. When students study science in their later years, Natural history is retained as a core basis for biology and environmental science, and adults continue to enjoy, learn about and advocate for the environment in their capacity as naturalists.

ACKNOWLEDGEMENTS

I am deeply indebted to Drs. J. Mondon and N. Katayama whose careful and thorough suggestions have led to significant improvements in this paper.

REFERENCES

Bailey, L. H. (1903) *The Nature-study Idea: Being an Interpretation of the New School-movement to Put the Child in Sympathy with Nature*, Doubleday, Page & Company, New York. (Reproduced by Legare Street Press in 2022).

Balme, D. M. (1991) Aristotle. *History of Animals, Books VII–X*, Harvard University Press, Cambridge, MA.

Evans, F. C. (1985) Address of the past president: Minneapolis, Minnesota; June 1985: In praise of natural history. *Bulletin of the Ecological Society of America* **66**: 455 – 460. https://www.jstor.org/stable/20166466

Gillies, W. (1904a) *First Studies in Insect Life in Australasia*: *With Numerous Questions, Directions for Outdoor Work, and Drawing and Composition Exercises*, Whitcombe & Tombs, Melbourne.

Gillies, W.(1904b) *First Studies in Plant Life in Australasia: With Numerous Questions, Directions for Outdoor Work, and Drawing and Composition Exercises*, Whitcombe & Tombs, Melbourne.

Gillies, W. and Hall, R. (1903) *Nature Studies in Australia,* Whitcombe and Tombs, Melbourne.

Hamilton, A.G. (1904) Nature study in primary schools. *Australian Journal of Education*, September 1904, pp.8-9; October 1904, pp.8-10.

Harris, T. (1945a) *Handbook of Nature Study for Teachers*, William Brooks, Sydney.

Harris, T. (1945b) *Nature Problems: A Book of Natural History for Australians*, William Brooks, Sydney.

Harris, T. (1945c) *Nature Problems: A Book of Nature Study for Young Australians*, William Brooks, Sydney.

Harris, T. Y. (1954) *The Teaching of Nature Study: A Practical Guide for Teachers in Primary Schools*, Australian Council for Educational Research, Melbourne.

Hodge, C. F. B. (1859) *Nature Study and Life*. Reproduced in 2016 by Palala Press.

Jackman, W. S. (1891) *Nature Study for the Common Schools*, Henry Holt, New York.

Kass, D. (2014a) The Nature Study idea: educational reform and environmental concern in

New South Wales, 1900-1920. (Unpublished Ph D thesis. Macquarie University). http://hdl.handle.net/10.25949/19438781.v1 <retrieved as PDF: 18/02/2023>

Kass, D. (2018) *Educational Reform and Environmental Concern. A History of School Nature Study in Australia.* Routledge. DOI 10.4324/9781315625256

Kitano, H. (2004) Current state of nature experiences activities and Nature Schools in Japan with special reference to educational reform. *Asian Journal of Biology Education* **2**: 50 – 57.

Larkin, J. Who'll spread Nature's word now? *The Age* 2 October 1970, p. 2.

Leach, J. A. (1905) Some practical hints on school work in nature-study. *Geelong Naturalist* **2** (1): 100 – 107.

Leach, J. A. (1909) Nature study and field work in Victoria. *Nature Study Review* Dec 1909: 222 – 226.

Leach, J. A. (1929) *Australian Nature Studies: a Book of Reference for Those Interested in Nature-Study,* Critchley Parker, Melbourne.

Long, C. R. (1905) *The Aim and Method in Nature-Study: A Lecture Delivered at a Congress of Teachers Held at Daylesford, Victoria, April, 1905*, MacMillan, Melbourne.

Mann, J., Gray, T., Truong, S., Brymer, E., Passy, R., Ho, S., Sahlberg, P., Ward, K., Bentsen, P., Curry, C. and Cowper, R. (2022) Getting out of the classroom and into nature: a systematic review of nature-specific outdoor learning on school children's learning and development. *Frontiers in Public Health* **10**: 877058. DOI 10.3389/fpubh.2022.877058.

Noss, R. F. (1996) The naturalists are dying off. *Conservation Biology* **10**: 1 – 3.

Presland, G. (2016) *Understanding Our Natural World. The Field Naturalists Club of Victoria 1880 – 2015*, FNCV, Blackburn, Victoria.

Price, G. G. (2019) Community environmental attitudes and the Victorian school curriculum: an historical narrative of their connections from 1835 to 2000. (Unpublished Ph D thesis. University of Melbourne).
https://minervaaccess.unimelb.edu.au/items/b8054e02-8d0d-52f2-9156-a5bd470e3ed3 <retrieved as PDF: 18/02/2023>

Rolls, E. C. (1984) *They All Ran Wild: The Animals and Plants that Plague Australia*, Angus and Robertson, Melbourne.

Scott, C. B. (1901) *Nature Study and the Child*, Isbister, London.

Seitz, T. A. (1939) Frank Tate. Grand Old Man of Education. *The Argus* 1 July 1939 p. 10. https://trove.nla.gov.au/newspaper/article/11247738?searchTerm=Frank%20Tate <retrieved as PDF: 18/02/2023>

Tate, F. (1903) Introduction. *In*: Gillies, W. and Hall, R. pp. ix – xvi. *op cit*.

WEBSITES

Australian Curriculum, Assessment and Reporting Authority
https://www.acara.edu.au/reporting/national-report-on-schooling-in-australia/year-12-subject-enrolments <accessed: 18/02/2023>

BBC (2022) Planet Earth II.
https://www.bbcstudios.com/annual-review <accessed: 12/01/2023>

BBC (2023) Life on Earth.
https://www.bbc.com/historyofthebbc/anniversaries/january/life-on-earth/ <accessed: 12/01/2023>

Haenggeli-Jenni, B. (2020) Education, teaching and professional training: Educating Europeans, New education. *EHNE, Digital Encyclopedia of European History.*
https://ehne.fr/en/encyclopedia/themes/gender-and-europe/educating-europeans/new-education <accessed: 18/02/2023>

Iberdrola (2023) Megadiverse countries. 10% of Earth's surface houses 70% of the planet's terrestrial biological diversity.
https://www.iberdrola.com/sustainability/megadiverse-countries <accessed: 12/02/2023>

Kass, D. (2014b) Nature Study Australia, 1890 – 1920. *Dictionary of Educational History in Australia and New Zealand (DEHANZ).*
https://dehanz.net.au/entries/nature-study/ <accessed: 18/02/2023>

Linnaean Society of New South Wales.
https://linneansocietynsw.org.au/ <accessed: 22/02/2022>

Tout-Smith, D. (2003) Acclimatisation Society of Victoria in Museums Victoria Collections
https://collections.museumsvictoria.com.au/articles/1803 <accessed: 22/02/2022>

Victorian Curriculum and Assessment Authority (a). Victorian Curriculum Foundation – 10.
https://victoriancurriculum.vcaa.vic.edu.au/ <accessed: 18/02/ 2023>

Victorian Curriculum and Assessment Authority (b). VCE Curriculum.
https://www.vcaa.vic.edu.au/curriculum/vce/Pages/Index.aspx <accessed: 18/02/ 2023>

Victorian Curriculum and Assessment Authority (c). VCE Study Designs - Biology.
https://www.vcaa.vic.edu.au/curriculum/vce/vce-study-designs/biology/Pages/Index.aspx <accessed: 18/02/ 2023>

Victorian Curriculum and Assessment Authority (d). VCE Study Designs - Environmental Science.
https://www.vcaa.vic.edu.au/curriculum/vce/vce-study-designs/environmentalscience/Pages/Index.aspx <accessed: 18/02/ 2023>

Victorian Curriculum and Assessment Authority (2016) *Victorian Certificate of Education OUTDOOR AND ENVIRONMENTAL STUDIES STUDY DESIGN.* Victorian Curriculum and Assessment Authority, Melbourne.
https://www.vcaa.vic.edu.au/Documents/vce/outdoor/2018OutdoorEnviroStdsSD.pdf <accessed: 22/11/2022>

Wikipedia (2022) Life on Earth (TV Series).
https://en.wikipedia.org/wiki/Life_on_Earth_(TV_series) <accessed: 18/02/2023>

*Table 1: Science curricula content and elaborations for levels F to 10**

Content description	*Elaborations*
Science/ Foundation to Level 2/ Science understanding/ Biological sciences	
Living things have a variety of external features and live in different places where their basic needs, including food, water and shelter are met	• recognizing common features of animals • describing the use of animal body parts for particular purposes e.g. moving, feeding • identifying common features of plants e.g. leaves, roots • recognizing that different living things live in different places e.g. land, water • exploring what happens when habitats change and some living things can no longer have their needs met
Living things grow, change and have offspring similar to themselves	• representing personal growth and changes from birth • exploring different characteristics of animal life stages e.g. butterflies, frogs
Science/ Levels 3 and 4 / Science understanding/ Biological sciences	
Living things can be grouped on the basis of observable features and be distinguished from non-living things	• exploring differences between living, once living and products of living things • identifying variations in the features of plants e.g. leaf colour and shape, number of legs • identifying variations in the features of animals e.g. body coverings, ear shapes, numbers of legs
Living things have different life cycles and depend on each other and the environment to survive	• making and recording observations of living things as they develop through their life cycles e.g. insects, birds, frogs, plants • recognizing that environmental factors can affect life cycles e.g. fire and seed germination • investigating the roles of living things in a habitat e.g. producers, consumers, decomposers • predicting the effects when living things in feeding relationships are lost
Science/ Levels 5 and 6 / Science understanding/ Biological sciences	
Living things have structural features and adaptations that help them to survive in their different environments	• explaining how particular adaptations aid survival e.g. nocturnal behaviour, silver coloured leaves of dune plants • describing and listing of adaptations of living things for particular Australian environments
The growth and survival of living things are affected by the physical conditions of the environment	• observing the growth of fungi e.g. yeast and bread mould in different temperature conditions • investigating how changing the physical conditions for plants impact on their growth and survival e.g. changing salt water concentrations using fertilisers or transferring to a different soil type • researching organisms that live in extreme environments e.g. Antarctica, deep sea, desert
Science/ Levels 7 and 8 / Science understanding/ Biological sciences	
There are differences between groups of organisms, classification helps organize this diversity	• grouping a variety of organisms on the basis of similarities and differences in certain features • classifying using hierarchical systems e.g. kingdom, through to species • using scientific conventions for naming species • using provided keys to identify organisms surveyed in a local habitat

Interactions between organisms can be described in terms of food chains and webs and can be affected by human activity	• constructing and interpreting food chains and webs to show relationships between organisms and the environment • recognizing the rate of microorganisms within food chains and webs • researching examples of human impacts on specific ecosystems e.g. Aboriginal use of fire, palm oil harvesting, deforestation, agricultural practices, introduction of new species
Science/ Levels 9 and 10 / Science understanding/ Biological sciences	
Multicellular organisms rely on coordinated and interdependent internal systems to respond to changes in the environment	• describing how the requirements for life are provided through body functions and systems e.g. circulatory • explaining using models, flow diagrams and simulations how body systems work together to maintain life • response of the body to change s resulting from presence of microorganisms
Ecosystems consist of communities of interdependent organisms and abiotic components of the environment; matter and energy flow through these systems	• exploring interactions between organisms e.g. predator/prey, pollinators, competitors • modelling to examine factors that affect population size e.g. introduced species, seasonal changes • ecosystem changes with environmental changes e.g. fire, drought, floods
The theory of evolution by natural selection explains the diversity of living things and is supported by a range of scientific evidence	• biodiversity as a function of evolution • natural selection – variation, isolation and selection • changes by natural selection e.g. selective breeding • evidence for evolution e.g. fossils, chemical and anatomical similarities, geographical distribution

*Source: https://victoriancurriculum.vcaa.vic.edu.au/science/introduction/scope-and-sequence <accessed: 18/02/2023>

Table 2: VCE Biology Study Designs – scope and activity relevant to Nature study*

VCE Biology

Scope: The study of Biology explores the diversity of life as it has evolved and changed over time, and considers how living organisms function and interact. It explores the processes of life, from the molecular world of the cell to that of the whole organism and examines how life forms maintain and ensure their continuity. Students study contemporary research, models and theories to understand how knowledge in biology has developed and how this knowledge continues to change in response to new evidence and discoveries. An understanding of the complexities and diversity of biology provides students with the opportunity to appreciate the interconnectedness of concepts and areas both within biology, and across biology and the other sciences.

Field work: Based on inquiry or the investigation of an issue, fieldwork involves observing and interacting with a selected environment beyond the classroom, usually in an attempt to determine correlation, rather than a causal relationship. It may be conducted through direct qualitative and/or quantitative observations and sampling, participant observation, interviews and questionnaires.

*Source: https://www.vcaa.vic.edu.au/Documents/vce/biology/2022BiologySD.docx <accessed: 18/02/2023>.

*Table 3: VCE Environmental Science Study Designs – scope and material relevant to Nature study**

VCE Environmental Science

Scope: Environmental science is an interdisciplinary, investigative science that explores the interactions and interconnectedness between humans and their environments and analyses the functions of both living and non-living elements that sustain Earth systems. Students investigate the extent to which humans modify their environments and the consequences of these changes in local and global contexts with a focus on biodiversity, pollution, food and water security, climate change and energy use. Students examine the challenges and opportunities presented by selected environmental issues and case studies, and consider how different value systems, priorities, knowledge and regulatory frameworks affect environmental decision-making and planning for a sustainable future.

Fieldwork: Based on inquiry or the investigation of an issue, fieldwork involves observing and interacting with a selected environment beyond the classroom, usually in an attempt to determine correlation, rather than a causal relationship. It may be conducted through direct qualitative and/or quantitative observations and sampling, participant observation, interviews and questionnaires.

Area of Study 1: How are Earth's systems organised and connected? Living organisms are able to survive in ecosystems as diverse as deserts, sea beds, the tropics and Antarctica, as well as in backyard gardens and ponds. In this area of study students analyse the range of components and processes that contribute to ecosystem functioning, and examine how events occurring in one of Earth's four interrelated systems can affect all systems to support life on Earth..

*Source: https://www.vcaa.vic.edu.au/Documents/vce/envscience/2022EnvironmentalScienceSD.docx <accessed: 18/02/2023>

*Table 4: VCE Outdoor and Environmental Studies Study Designs – scope and material relevant to Nature study**

Scope: VCE Outdoor and Environmental Studies is concerned with the ways humans interact with and relate to outdoor environments. 'Outdoor environments' covers environments that have minimum influence from humans, as well as those environments that have been subject to different levels of human intervention. The study enables students to make critically informed comment on questions of environmental sustainability and to understand the importance of environmental health, particularly in local contexts.

Unit 1: Area of Study 1 - Motivations for outdoor experiences

In this area of study students examine motivations for and responses to nature and outdoor experiences. They investigate a range of contemporary uses and meanings of the term 'nature' and examine a variety of different types of outdoor environments. Students are introduced to a cultural perspective on the ways humans relate to outdoor environments. *Key knowledge* includes the

- range of differing personal responses to outdoor environments, such as fear, appreciation, awe and contemplation
- a variety of ways in which people know, experience and respond to outdoor environments:
    - as a resource, for recreation and adventure, spiritual connection and
    - as a study site through experiential knowledge, environmental history and ecological, social and economic perspectives.

Unit 2: Area of Study 1 - Investigating outdoor environments

This area of study introduces students to the characteristics of a variety of outdoor environments, including those visited during practical outdoor experiences. Students investigate different types of outdoor environments from a number of perspectives. They undertake case studies of different types of outdoor environments to observe and experience how changes to nature affect people. *Key knowledge* includes:

- scientific understandings of specific outdoor environments, including:
    - interrelationships between biotic and abiotic components
    - effects of natural changes to environments on people and places such as day to night, seasons, tides, flood, drought, migration, succession, and climate change

- the effect fire (both wildfire and controlled burns) has on the environment
- artistic, Indigenous, and historical understandings of specific outdoor environments.

Unit 3: Area of Study 1 - Relationships with outdoor environments

The focus of this unit is the ecological, historical and social contexts of relationships between humans and outdoor environments in Australia. Case studies of a range of impacts on outdoor environments are examined in the context of the changing nature of human relationships with outdoor environments in Australia. *Key knowledge* includes

- an overview of Australian outdoor environments before humans, including characteristics of biological isolation, geological stability, and climatic variations
- relationships with Australian outdoor environments expressed by specific Indigenous communities before and after European colonisation
- relationships with Australian outdoor environments as influenced by: the first non-Indigenous settlers' experiences; increasing population; industrialisation; nation building
- the foundation and role of environmental movements in changing relationships with outdoor environments, in relation to at least one of the following: Lake Pedder (Tasmania) The Little Desert (Victoria) The Franklin River (Tasmania)
- the impact of increasing environmental awareness in Australia on the policies of political parties.

Unit 4: Area Study 1 - Healthy outdoor environments

In this unit students explore the sustainable use and management of outdoor environments. They examine the contemporary state of environments in Australia, consider the importance of healthy outdoor environments, and examine the issues relating to the capacity of outdoor environments to support the future needs of the Australian population. *Key knowledge* includes

- understandings and critiques of sustainability and sustainable development
- observable characteristics of healthy outdoor environments, including:
  - quality and adequacy of water, air and soil
  - amount of biodiversity
  - –amount of pest and introduced species
- the state of outdoor environments in Australia, with reference to common themes used in the current national State of the Environment report
- • the importance of healthy outdoor environments for individual physical and emotional wellbeing, and for the future of society
- • the potential impact on society and outdoor environments of land degradation, introduced species, climate change, urbanisation and other significant threats.

Unit 4: Area of Study 2 - Sustainable outdoor environments

This area of study explores the contemporary state of outdoor environments in Australia and the importance of outdoor environments for individuals and society. Students examine the nature of sustainability and use observations to evaluate the health of outdoor environments. They investigate current and potential damage to outdoor environments and the subsequent impacts. *Key knowledge* includes

- at least two recent or current conflicts over the use of outdoor environments, including at least one from the following: – marine national parks and sanctuaries – grazing in the Alpine National Park – desalination plant at Wonthaggi – proposed Great Forest National Park – extraction of coal seam gas
- the methods used by individuals and groups to influence decisions about the use of outdoor environments
- the processes followed by land managers and/or governments or their agencies relating to conflicts over the use of outdoor environments, including community consultations, use of court systems, legislation and management plans
- management strategies for achieving and maintaining healthy and sustainable outdoor environments that may be adopted by public and private land managers
- acts or conventions related to the management and sustainability of outdoor environments actions undertaken to sustain healthy outdoor environments.

---

*Source: https://www.vcaa.vic.edu.au/Documents/vce/outdoor/2018OutdoorEnviroStdsSD.pdf <accessed: 22/11/ 2022>.

Asian Journal of Biology Education, 2023
https://doi.org/10.57443/ajbe.15.0_36

Practical Note

Comparison of Traditional Lecture Using Slideshow and Teaching with Virtual Manipulations Software

Iris Mae L. CAIDIC [1], Christer John P. FABONAN [2]*, Eva B. MARANAN [2]
[1] Kids' World Christian Academy, [2] University of Rizal System, Philippines

(Received: 01 August 2022; Accepted for publication: 6 June 2023)

This paper deals with the study on the use of *Froguts* as an edtech tool for teaching anatomy in a grade 9 online class which aims to examine the effectiveness of teaching with virtual manipulations software. In this study, a quasi-experimental design only with posttest was utilized. Twenty-four students participated in the study, with the control group receiving a traditional lecture using slideshow and the experimental group taking the same lesson with navigating *Froguts* virtual dissection. Two-tailed *t*-test for the posttest results revealed no significant difference in the learning acquisition between the use of *Froguts* virtual software and the traditional online lecture using slideshow. Basic anatomical structures of the frog can be learned easily by attending a traditional lecture with a slideshow setup in an online environment. It is recommended to conduct a similar study on assessing a higher level of learning in the Bloom's taxonomy with more participants and applying a time series design.
***Key words**: anatomy, dissection,* Froguts *virtual software, knowledge acquisition, technology integration*
***Author for correspondence:** Email address: christerjohnfabonan@gmail.com

INTRODUCTION

The sudden switch to online mode of learning delivery of many high schools due to the COVID-19 pandemic has left the teaching personnel wondering about effective means of delivering science lessons to high school students in a purely online mode. Facilitating a science lesson is faced with many challenges, which include how to craft well-guided practical experimentations, effectiveness of the laboratory activities, and measuring the learning outcomes of these activities. Ensuring students' safety in the execution of experiments is also a primary challenge. Performing anatomy experiments online has similar challenges so online anatomy applications were used as an alternative option.

Computer-based simulations offer an appropriate constructive learning environment (Apkan, 2002) as it provides "Contrived Experiences", which are considered second to the most concrete experience in Dale's Cone of Experience (Janoska, 2017). Simulations also present several sensory modalities such as touch, sight and hearing, altogether at one time (Pérez-López and Contero, 2013). This enables learners to be actively involved in the learning process (Fleming and Mills, 1992). Since learners can experiment and make mistakes in this flexible, risk-free setting, learning is made more interesting and engaging thereby increasing retention (Ibrahim and Al-Shara, 2007).

Virtual Simulations were used in secondary schools as well, such as *Froguts* Virtual Frog Dissection, a software that can be downloaded for free (The Science Bank, n.d., see Websites list). *Froguts* was found to be an effective alternative to actual dissection (Apat, 2019) under the assumption that use of the application could increase knowledge acquisition, at least at the Remember stage of learning, by enabling the students to do the dissection in an online setup (Figure 1).

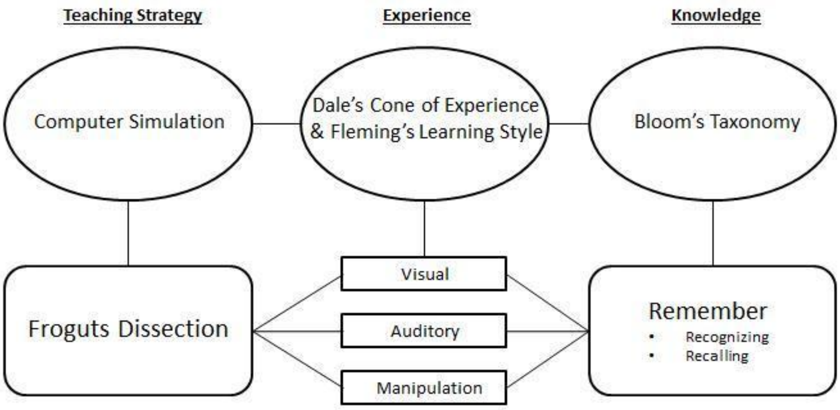

Figure 1: Knowledge acquisition through virtual manipulation

PROCEDURE

In this study, we applied *Froguts* in teaching anatomy in a grade 9 Science class that was being delivered in a pure virtual setup to test the null hypothesis that there is no significant difference between the scores of students who learned frog's anatomy through *Froguts* virtual dissection and those who attended a regular online lecture. Twenty-four grade 9 students from a private high school from San Mateo, Rizal, Philippines, participated in this study. The students were categorized according to their average grade (AG) in Science from the previous school year: top group (AG ≥ 90%), middle group (AG = 84% - 89%), and bottom group (AG ≤ 83%). We selected eight learners from each group. Aided by randomized grouping, students of each category group were equally divided into control and experimental groups. The anatomy class sessions for the control and experimental groups were facilitated separately. During the class period, the groups were assigned to separate online breakout rooms. Both groups were given one hour to complete the lesson and 20 min to complete the assessment.

The control group was given a regular lecture where the lesson was delivered by the teacher using a slide presentation about the basic external and internal parts of a frog. The contents of the slide presentation were essentially figures adopted from *Froguts*. On the other hand, the experimental group was given the same lesson with navigating *Froguts* in their own device.

The students in the experimental group were instructed to download the *Froguts* application at the start of class to make sure it is their first time using the application during the discussion of the topic and to put everyone on a baseline of knowledge and familiarity. Both groups were given the same assessment that contains a 15-item multiple-choice question (MCQ) quiz with one mark for each question. The assessment was administered right after the lesson (Figure 2).

RESULTS

A posttest-only comparison group design was utilized in this research to examine whether there is a difference between test scores of students who learned frog's anatomy through *Froguts* virtual dissection and those who attended a regular online lecture class.

The mean scores of the posttest presented in Table 1 show a negligible difference between the control and experimental groups and across all AG

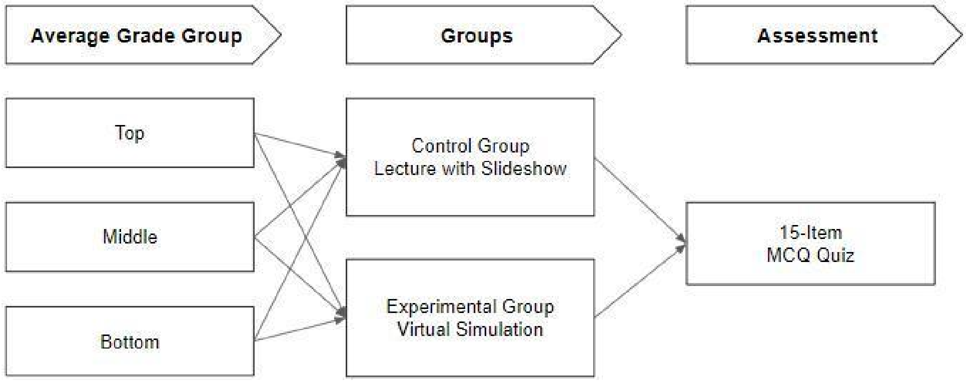

Figure 2: Procedure of learning delivery

Table 1: Results of the posttest* of the control and experimental groups

AG group	Control group (Ave)	Experimental group (Ave)
Top	15	15
Middle	13	13
Bottom	12	12
Mean (X̄)	13	13

*The highest possible score was 15.

groups. The overall mean score for both the control group and the experimental group was 13. The computed *t*-value (0.095) is less than the critical value (2.074), so the null hypothesis was not rejected. The result also shows that there is no is no sufficient evidence that there is a significant difference between the assessment scores of the control and the experimental groups the control and the experimental groups at the 0.05 level of significance (Table 2).

The internal validity of the assessment was checked based on its content, relevance, and relatedness to the set objectives anchored at the aim of gaining an immediate recall of important concepts in frog's anatomy at the "Remember level of learning" in Bloom's taxonomy. To check the reliability of the items, Kuder-Richardson Formula 20 (SPSS for Windows, Version 16.0, SPSS Inc., Chicago) was used to measure internal consistency. The computed reliability coefficient was 0.72, which is indicative that the instrument was reliable.

DISCUSSION

From the findings of this study, it was concluded that there is no significant difference between the performance, at least at the remembering level of the organs and their functions, of the students who have undergone an anatomy class using *Froguts* and those who have attended a lecture-only class with slideshow of anatomical details of a frog. This is similar to the results of William *et al*. (2016) and Akhu-Zaheya *et al*. (2013) where no significant difference was presented between the students who used the technology-assisted simulations and those who were immersed in the traditional method. Furthermore, Pérez-López and

Table 2: Two-tailed t-test analysis of the results

Degrees of Freedom	*t*-value	*p*-value	Critical Value	Level of Significance
22	0.095	0.925	2.074	0.05

Contero (2013) also found out that the differences in grades were random and had no statistical significance between the learning unit taught using a simulation and one taught traditionally.

In the present study, the students from the control group performed in the formative assessment just as fair as those who have used the *Froguts*. It could be inferred that learning acquisition of basic anatomical structures of the frog can be done easily by simply attending a traditional lecture with a slideshow setup in an online environment. Flashing the photos of organs while explaining their functions may suffice for retaining anatomical details.

Although there was no significant difference in the overall scores between the control and experimental groups, there was time constraint in the use of the *Froguts* as the students had to follow the pace of the discussion without staying on a certain part of the dissection activity to gain more hands-on experience. With the findings we have gathered as well as the observations while conducting this study, it is recommended: *(a)* to apply a higher level of assessment for measuring learning acquisition other than remembering anatomical details; *(b)* to conduct a similar study in other private and public schools with multiple grade levels where anatomy is part of Science lessons for enhancing the validity and reliability of the results; and *(c)* to factor in the time between the exposure to the treatment and the assessment by applying a time series design.

REFERENCES

Akhu-Zaheya, L. M., Gharaibeh, M. K. and Alostaz, Z. M. (2013). Effectiveness of simulation on knowledge acquisition, knowledge retention, and self-efficacy of nursing students in Jordan. *Clinical Simulation in Nursing* **9**(9): e335–e342.

Apkan, J. (2002). Which comes first: computer simulation of dissection or a traditional laboratory practical method of dissection. *The Electronic Journal for Research in Science & Mathematics Education* **6**(4): 2.

Apat, J. (2019). Froguts Virtual Dissection: Alternative to Physical Dissection for Biology Basic Education. *International Journal of Scientific & Engineering Research* **10**(1): 444-451.

Fleming, N. D. and Mills, C. (1992) Not another inventory, rather a catalyst for reflection. *To Improve the Academy* **11**(1): 137-155.

Ibrahim, M. and Al-Shara, O. (2007) Impact of interactive learning on knowledge retention. *In*: Smith, M. J. and Salvendy, G. (eds.) *Human Interface and the Management of Information. Interacting in Information Environments (Proceedings of the Symposium on Human Interface 2007).* pp. 347-355. Springer. https://link.springer.com/book/10.1007/978-3-540-73354-6?page=3#toc

Pérez-López, D. and Contero, M. (2013) Delivering educational multimedia contents through an augmented reality application: a case study on its impact on knowledge acquisition and retention. *Turkish Online Journal of Educational Technology* **12**(4): 19-28.

William, A., Vidal, V. L. and John, P. (2016) Traditional instruction versus virtual reality simulation: A comparative study of phlebotomy training among nursing students in Kuwait. *Journal of Education and Practice* **7**(9): 18-25.

WEBSITES

Janoska, L. (2017) What Really Is the Cone of Experience? *eLearning Industry*. Retrieved from: https://elearningindustry.com/cone-of-experience-what-really-is

The Science Bank (n.d.) *Froguts* [Computer software] Retrieved from: https://thesciencebank.org/pages/froguts

Asian Journal of Biology Education, 2023
https://doi.org/10.57443/ajbe.15.0_40

Miscellaneous Article

AABE – Sixty Years On

Nobuyasu KATAYAMA
Tokyo Institute of Biology Education, Japan
katayama@u-gakugei.ac.jp

(Received for publication: 2 October 2023)

PREFACE

In 2026, the Asian Association for Biology Education (AABE) will reach its sixtieth year. At this occasion, I would like to present an overview of AABE's goals and its achievements.

WHAT IS AABE?

The AABE is an academic organization of biology educators, biology researchers and those interested in biology education mainly in the Asian Region. It was established in 1966 by joining many leading biology teachers, educators and researchers among Asian countries. It is a non-profit organization whose secretariat has continuously been located in Manila, Philippines (The first Secretary was Dr. Dolores F. Hernandez, the second was Dr. Carmen G. Kanapi, the third was Dr. Lucille C. Gregorio, and the fourth = present = is Dr. Jessamyn M. O. Yazon). Its current members are university academic staff, school teachers, education research personnel, administrators and others, including retirees, who are keen to exchange ideas on biology education.

WHAT ARE THE AIMS OF AABE?

According to its Constitutions and Rules (see Websites list), the aims of AABE are as follows:

(1) To improve the teaching of and promote research in biology, in Asian countries;
(2) To bring together biology teachers and educators of Asian countries at meetings held biennially;
(3) To establish an agency in Asia to serve as a center for the exchange of teaching materials, journals and research papers, specialists and teachers in biological science, and to open channels of communication between this agency and agencies in different countries doing similar work;
(4) To promote the creation of biological science teaching and research centers in each Asian country.

WHAT HAS AABE DONE AND WHAT IS AABE DOING?

Biennial Conference

In 1966, the first conference of the association was held in Manila. After that until 2018, the AABE held its conferences in the even-numbered years biennially at cities mostly in Asian countries (Table 1, at the end of this paper).

At the first, the conference was named as the "Asian Regional Conference on School Biology." This name was used until the third conference and renamed as the "Asian Regional Conference in Biology Education." From the seventh conference onward, it has been simply called the "Biennial Conference." The 28th Biennial Conference was firstly planned to be held in 2020 at Tianjin, China, however, it was postponed because of the COVID19 pandemic and was held online in April, 2022, managed by Philippines members. The 29th conference will be held onsite at Matsuyama City, Japan, in October, 2024. These conferences are usually structured to enable presentations which relate to one or a few specific themes. At each conference, some keynote lectures and some country reports are given. Also, oral or poster presentations of general research reports are invited.

Figure 1 shows the number of registrants and of presentations in each biennial conference held at or after 2000. As the 28th conference was held online, the number of registrations is uncertain (but the number of online audience was more than 350). The number of registrants decreased from the 18th to the 21st conferences but increased from the 22nd to the 26th conferences. The number of presentations has changed in parallel with the number of registrants.

Some photos of biennial conferences are shown in Figures 2 – 9. A group photo of attendees of each biennial conference from the 23rd onwards has been included in the conference report in the Asian Journal of Biology Education (see References list).

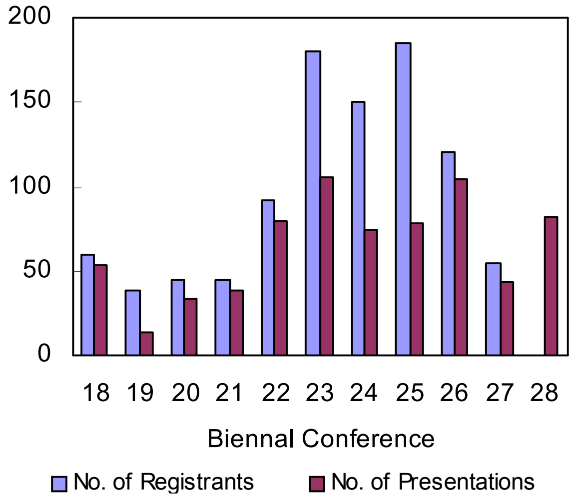

Figure 1: The Number of Registrants and of Presentations in Each Biennial Conference Held at or after 2000

Figure 2 (left): Some Attendees of the 10th AABE Biennial Conference Returning from the Educational Tour (Chiang Mai, December 1984)
Figure 3 (right): Attendees of the 11th AABE Biennial Conference (Quezon City, December 1986)

Figure 4: At the 12th AABE Biennial Conference (New Delhi, December 1988)

Figure 5: At the 13th AABE Biennial Conference (Seoul, August 1990)

Figure 6: Attendees of the 15th AABE Biennial Conference (Tokyo, August 1994)

Figure7 (left): At the 16th AABE Biennial Conference (Chiang Mai, December 1996)
Figure8 (right): At the 19th AABE Biennial Conference (Warrnambool, November 2002)

Figure 9: Attendees of the 22nd AABE Biennial Conference (Osaka, November 2008)

Publication of the Proceedings of each Conference

A book of the proceedings of each Biennial Conference (Figure 10) was published until 1998. A table of contents of each proceedings has been reprinted in the 10th volume of Asian Journal of Biology Education (see References list).

Figure 10: Front covers of the Proceedings of AABE Biennial Conferences (From 1st to 17th)

Publication of an Academic Online Journal

In 2002, the publication of an online journal (Asian Journal of Biology Education or abbreviated as AJBE) was started instead of publishing printed Proceedings. At first, the journal was published on a website in the server of Deakin University, Australia. Professor Robert Wallis and Dr. Laurie Laurenson at the university established the site of the AJBE publication. In 2011, the website was moved to the present URL*. So far, 14 volumes of the journal have been published. The abstracts of papers presented at each conference together with a conference report were included in the journal (see References list). There are six categories of articles in AJBE, namely, reviews, research papers/research notes, practical reports/practical notes, biological resources, country reports, and other articles. Table 2 shows the number of articles of each category in each volume of AJBE. At the beginning, only research papers and some other articles were refereed, but from the volume four onward all manuscripts except those of country report have been refereed. (Some country reports published on AJBE were refereed on request). So, the number of published articles in volume four and subsequent volumes is smaller than that in previous ones. In 2022, the journal has registered at J-stage, one of the information of research paper retrieval online sites.

* http://www.aabe.sakura.ne.jp/Journal.htm

Publication of a Newsletter

Until 2000, the AABE had published 10 newsletters. However, as the Internet became popular, it was decided there was no need for a newsletter. Thus, at present, all news and announcements are published on the AABE website or sent to each member by email.

Other

The AABE published a booklet (Figure 11) at an opportunity of its 30th anniversary to survey its past activities.

Table 2: The Number of Articles Published on Each Volume of AJBE:

Volume	Number of Articles	Research Papers/ Research Notes	Practical Reports/ Practical Notes	Biological Resources	Country Reports	Others
1	9	8				1*
2	10	8	1*			1**
3	10	3	1*	6		
4	5	2	2		1	
5	4	2	1		1	
6	2	2				
7	3	2	1^N			
8	1	1				
9	1	1				
10	2		1		1	
11	4	1^N		1	2*	
12	3			3		
13	4		$2 + 1^N$	1		
14	3		1^N		1 + 1*	

^{N}: Research Note or Practical Note; *: Un-refereed article; **: Invited article

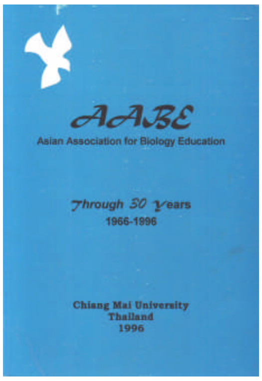

Figure 11: The commemorative booklet for AABE 30th Anniversary published in 1996

PERSPECTIVE ON ACTIVITIES OF THE AABE

For the last several decades, biological research has made remarkable progress. This makes us review the study contents of biology and biology curriculum frequently. The biennial conference of the AABE is a good opportunity for us to exchange information, ideas, teaching materials, etc. I keenly hope the activity of AABE will be continued and enhanced more in this millennium.

ACKNOWLEDGEMENT

I am very much grateful to Professor Robert Wallis at Federation University, Australia, for his useful suggestions and critical comments to complete this manuscript.

REFERENCES

Anon. (2004) Abstracts of the papers presented at the 19th Biennial Conference of the AABE. *Asian Journal of Biology Education* **2**: 6-93.

Anon. (2007) Abstracts of the papers presented at the 20th Biennial Conference of the AABE. *Asian Journal of Biology Education* **3**: 5-92.

Anon. (2010) Abstracts of the papers presented at the 21st Biennial Conference of the AABE. *Asian Journal of Biology Education* **4**: 3-54.

Anon. (2010) Abstracts of the papers presented at the 22nd Biennial Conference of the AABE. *Asian Journal of Biology Education* **4**: 5-94.

Anon. (2011) Abstracts of the papers presented at the 18th Biennial Conference of the AABE. *Asian Journal of Biology Education* **5**: 3-57.

Anon. (2012) Abstracts of the papers presented at the 23rd Biennial Conference of the AABE. *Asian Journal of Biology Education* **6**: 6-77.

Anon. (2013) Abstracts of the papers presented at the 24th Biennial Conference of the AABE. *Asian Journal of Biology Education* **7**: 1-63.

Anon. (2015) Abstracts of the papers presented at the 25th Biennial Conference of the AABE. *Asian Journal of Biology Education* **8**: 7-53.

Anon. (2016) Abstracts of the papers presented at the 26th Biennial Conference of the AABE. *Asian Journal of Biology Education* **9**:11-77.

Anon. (2018) Contents of the Proceedings of past biennial conferences of the AABE. *Asian Journal of Biology Education* **10**: 17-39.

Anon. (2019) Report of the 27th Biennial Conference of the AABE and abstracts of the papers presented at the conference. *Asian Journal of Biology Education* **11**: 25-45.

Anon. (2022) Conference report of the 28th Biennial Conference of the AABE and abstracts of the papers presented at the conference. *Asian Journal of Biology Education* **14**: 21-61.

WEBSITES

Asian Association for Biology Education: http://www.aabe-asia.org / http://www.aabe.sakura.ne.jp/

Table 1: A List of Biennial Conferences of the Asian Association for Biology Education

	Date	City (Country)	Director and Convener	Conference Theme(s)	No. of Registrants [No. of Countries]
1	Dec. 1966	Manila (Philippines)	Liceria B. Soriano Dolores F. Hernandez	School Biology in Asia: A New Orientation	100 [14]
2	August 1968	Tokyo (Japan)	Yoshito Shinoto Kazuhiko Nakayama	Enrichment of School Biology: Content and Techniques	107 [15]
3	Dec. 1970	Manila (Philippines)	Hilary Crusz Dolores F. Hernandez	The Utilization of Investigative Research Projects in School Biology Teaching: Reflect the Peculiarities of the Region	45 [13]
4	Dec. 1972	Jerusalem (Israel)	Alexandra Poljakoff-Mayber R. Bitman	1. Evaluation in Science Education 2. The Uses of Educational Technology in Science Education	101 [15]
5	June 1974	Singapore	Wee Heng Tin John Yip	Biology Education for Rural and Urban Areas in Asia	116 [9]
6	July-Aug. 1976	Bangkok (Thailand)	Twee Hormchong Sanga Sappasri	Preparation of Teachers for Biology Teaching	101 [13]
7	Dec. 1978	Kuala Lumpur (Malaysia)	Cheong Siew Yoong S. Kanagasabai	Multidisciplinary Biology Education Relevant to Community Development	157 [12]
8	Oct.-Nov. 1980	Osaka & Gifu (Japan)	Kozo Imahori Yutaka Koshida	Biology Education for the Next Decade - Linking Biology to Social Studies - Using Living Organisms for Field Study and Laboratory Work	80 [21]
9	Dec. 1982	Melbourne (Australia)	David M. Stakes Robert L. Wallis	The Role of Biology Education in Enhancing the Quality of Life	39 [6]
10	Dec. 1984	Chiang Mai (Thailand)	Panee Chiowanich Morakot Sukchotiratana	Biology Education and Technology	50 [5]
11	Dec. 1986	Quezon City (Philippines)	Dolores F. Hernandez Vincenta F. Reyes	Research and Evaluation in Biology Education and Its Implication for the Teachers	120 [12]
12	Dec. 1988	New Delhi (India)	R. K. Mohta B. G. Pitre	Explosion of Biological Knowledge and the Challenges for Secondary Education and Teacher Preparation	21 [5]
13	August 1990	Seoul (Korea)	Yong Jai Chung Yung Chil Hah	Environmental Education in the Curriculum of Biological Education	Ca.65 [7]
14	Dec. 1992	Melbourne (Australia)	Robert L. Wallis Peter Brown	Environmental management in Asia	53 [7]
15	August 1994	Tokyo (Japan)	Yutaka Koshida Hideo Kitano	Biology Education for Non-biology Majors	107 [7]
16	Dec. 1996	Chiang Mai (Thailand)	Morakot Sukchotiratana	Excellence in Biology Education: Research, Practice and Experience	ca.120 [10]
17	Dec. 1998	Pasai City (Philippines)	Carmen G. Kanapi Salvasion P. Angtuaco	Biology Education in the Third Millennium: Focus on Information Technology and Environmental Education	ca.150 [6]
18	August 2000	Hong Kong	Park L. Tang	Biology Education in the New Millennium	ca 60 [9]
19	Nov. 2002	Warrnambool (Australia)	Robert L. Wallis	Ecological Sustainable Development in Education	38 [6]
20	Dec. 2004	Chiang Mai (Thailand)	Morakot Sukchotiratana	Roles of Modern Technologies in Biology Education	ca.45[4]
21	Oct. 2006	Gongju (Korea)	Kyoung Ho Kim Kew Cheol Shim	Biology Education through Field Excursion: Bird Watching Recent Trends in Biology Education	ca.45[4]
22	Oct. 2008	Osaka (Japan)	Nobuyasu Katayama Koichi Morimoto	The Role of Biology Education in Society Today Biology Education for Realizing the Preciousness of Life Biology Education in "The UN Decade of Education for Sustainable Development"	92 [8]
23	Oct. 2010	Singapore	C H Diong Mijung Kim	Biology Education for Social and Sustainable Development	180 [17]
24	Dec. 2012	Quezon City (Philippines)	Rosie S. Madulid Jessamyn M. O. Yazon	The Century of Biology: Towards Transformative Education	ca.150 [10]
25	Oct. 2014	Kuala Lumpur (Malaysia)	Esther G. S. A. Daniel Carolina Lopez	Biology Education and Research in a Changing Planet	185[10]

26	Sept. 2016	Goa (India)	Narendra D. Deshmukh Suhas J.Godse	Trends in Biology Education & Research: Practices & Challenges	120[4]
27	Nov.-Dec. 2018	Bangkok (Thailand)	Churdchai Cheowtirakul Tatsaporn Todhanakasem	Biology Education for Future Asia	55[8]
28	April 2022	Online (Philippines)	(A joint conference with BIOTA-Philippines)	Biology Research and Education: Recalibrating under the New Normal	Unclear*
29	October 2024	Matsuyama (Japan)	Kiyoyuki Ohshika Heiwa Muko	Perspectives for Global Well-being: Biology Education in the Integrated Learning	

* The number of online audience was more than 350.

From the Editor-in-Chief

I am Shigeki Mayama, taking over as Editor-in-Chief from Dr. Katayama starting with this volume of the Asian Journal of Biology Education (AJBE). Dr. Katayama has led AJBE for 20 years since it began in 2002, passionately contributing to advancing biology education in Asia through the journal. I aim to continue his work, working to expand the reach of this journal, and I'm excited to collaborate with AABE members and AJBE readers.

Since last year, we've assigned DOIs to all papers, making them accessible to the public through J-Stage (https://www.jstage.jst.go.jp/browse/ajbe/list/). J-Stage, run by the Japan Science and Technology Agency (JST), is an electronic journal platform that facilitates the publication of journals. Bibliographic data of articles on J-Stage are sent to databases like Google Scholar, allowing global access to papers published in AJBE.

Starting from vol. 15, individual papers are released on J-Stage as "Online First" before being published in a single volume. This gives authors the advantage of early publication. Consequently, the individual papers featured in this vol. 15 have already been published on J-Stage, including one opinion, three country reports, one practical report, and one miscellaneous.

Over the past two years, manuscripts contributed to AJBE have undergone peer review by individuals, including Editorial Board members and the following: Professor Hiroaki Asaga (Meiji University, Japan), Ms Kwan Mei Yam (The Chinese University of Hong Kong, HKSAR), Dr. Sonia D. Jacinto (The University of the Philippines, Diliman, Philippines), Professor Takeshi Katayama (Takasaki University of Health and Welfare, Japan), and Professor Robert Wallis (Federation University, Australia). I express my sincere gratitude for their dedicated efforts in critically reviewing the manuscripts.

To elevate AJBE into a premier journal, we encourage submissions from our readers. The overall quality of the journal is enriched by a substantial number of manuscripts and the vibrant discussions that occur during the peer-review process. I enthusiastically welcome submissions to AJBE in all fields related to biology education and environmental education. I appreciate everyone's cooperation and support in this endeavor. Thank you.

Dr. Shigeki Mayama (mayama@u-gakugei.ac.jp)