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VIRTUAL GARDEN: DEVELOPMENT AND STUDENT'S PERCEPTIONS

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Abstract

The classification of living things learning in school faced some obstacles, one of which was the difficulties in presenting the specimen of real living things. One of the advanced information and technology products in the form of digital or virtual-based learning media was expected to be the solution to this problem. Through this research, a virtual garden learning media was developed as an alternative learning media for the classification of living things. This development research (Design-Based Research) used an ADDIE model (Analyze, Design, Develop, Implement, and Evaluate), which consisted of five stages: analysis, design, development, implementation, and evaluation. The development of the Virtual Garden application started with creating the workflow and wireframe, creating the 3D asset using Blender Software, producing the virtual garden interactive media using Unity-3D software, and adding the C# programming. This research involved an expert in learning media and an expert in Science Learning content as the validators. The results of Virtual Garden validation showed that this application had been valid and relevant to be used as a Science/Biology learning media on the classification of living things topics. Based on the implementation results, the students gave positive responses to the use of Virtual Garden in learning.

Keywords – Virtual garden, Virtual tour, Classification of living things.

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1. Introduction

The COVID-19 pandemic has the potential to trigger enormous impacts on biodiversity and conservation (Pearson, Sievers, McClure, Turschwell & Connolly, 2020). Several facts show that there are phenomena and events that have positive and negative impacts on biodiversity during the pandemic and lockdown due to the pandemic. For example, during a lockdown, a reduction in ecotourism activity and human presence can help species sensitive to anthropogenic pressure to thrive, which can be seen from the increased success of animal reproduction programs at zoos, reintroduction programs for vulnerable species, and sightings of wildlife close to human habitation. from around the world (Moulds, 2020). In contrast,

deforestation rates in the Amazon rainforest increased by 55% in the first four months of 2020 compared to the same period last year, the destruction of centuries-old coral reefs in the Caribbean due to lack of treatment for fungal diseases, and the proliferation of invasive species such as rats that are destroying species. native and habitat in an island nation such as New Zealand in the absence of eradication efforts (Bancroft, 2020; Brown, 2020; Ma'ia'i, 2020).

Concerns about biodiversity loss and ethical issues related to sustainable use remain at the heart of education for sustainable development (Girault & Sauvé, 2008; Sauvé, 1996). A number of studies have shown that education and training are the most effective drivers for conserving biodiversity (Girault, Quertier, Fortin-Debart & Maris, 2008; Girault & Alpe, 2011; Legardez & Simonneaux, 2006; Sauvé, 1996). Awareness and understanding of the younger generation regarding the need to protect biodiversity can be realized through a rational approach. This means that if he understands that humans are part of nature and that their activities must pay attention to the needs of mankind but without draining the ecosystem that must be preserved for future generations of living things (Girault et al., 2008; Maskour, Alami, Zaki & Agorram, 2019; Sauvé, 1996).

Biodiversity should be included in all teaching and learning projects, curricula and teaching materials (UNESCO, 2012). The learning outcomes designed must include theoretical understanding, value building, skills development and adoption of attitudes that are conducive to biodiversity conservation. In addition, to preserve plant and animal species, we must first know them, know their biological aspects and know how to identify and classify them (Maskour et al., 2019). Several learning strategies are applied to teach the classification of living things, including: using a number of questions to identify native specimens (Bebbington & Council, 2005; Rosenheck, Levin & Levin, 1989), picture cards (Stagg & Donkin, 2015), with the aid of a dichotomy key (Anđić, Cvijetićanin, Maričić & Stešević, 2018; Rosenheck et al., 1989), with the Word Association Exercise Based on Mnemonics Approach (Rosenheck et al., 1989; Stagg & Donkin, 2015), assisted by An Electronic Multi-Access Key (Stagg, Donkin & Smith, 2015), assisted by iOS app on the iPod for plant identification guide (Stagg & Donkin, 2015), and Interactive Multimedia Dichotomous Key for Plant Identification (Jacquemart, Lhoir, Binard & Descamps, 2016).

Efforts to realize learning outcomes during a pandemic have become a challenge, especially in learning that requires direct interaction with objects or learning resources, such as on the topic of classification of living things. Today many universities and research institutes around the world have been closed or restricted. Direct teaching and learning is transformed into distance or online by utilizing Information and Communications Technology (ICT). Therefore, it is necessary to develop an innovation to overcome these problems, especially those related to learning media. Through the right learning media, the Science-Biology learning process can be more understood and easily accepted by students, even for certain things, for example in learning, it can make a broad scope more practical to be introduced in class (Sahronih, Purwanto & Sumantri, 2019).

One of the products of advances in information and communication technology in the form of virtual-based learning media is expected to be a solution to learning problems during the pandemic. Virtual-based multimedia has been developed and applied to various science lessons, such as the solar system and organ systems in humans (Kartiko, Kavakli & Cheng, 2010).Through the use of these media, many teachers are helped and the learning process tends to be more interactive. Even these learning media are now equipped with various interesting features so that two-way communication can occur or is called interactive learning media (Sahronih et al., 2019). The use of interactive multimedia for science learning is widely reported. However, publications regarding the results of multimedia development for the topic of classification of living things are still limited. Therefore, this article aims to describe the development of a computer application called Virtual Garden as an alternative medium for learning the classification of living things and students' perceptions of the use of Virtual Gardens in learning.

2. Design/Methodology/Approach

This development research (Design-Based Research, DBR) uses the ADDIE model, which is an acronym for Analyze, Design, Develop, Implement, and Evaluate (Branch, 2009). In the analyze stage, analysis activities are carried out on the characteristics of students, characteristics of topics/materials, basic competences analysis, and literature studies to develop flowcharts and storyboards of learning media that will be developed. At the design stage, the virtual garden was developed using Blender software which was used as a 3D asset creation software which was later inputted into Unity-3D software and added C# programming to make it an interactive medium. At the develop stage, the virtual garden application that has been created is then reviewed/validated by two experts (one expert on learning media and one expert on learning content). The recommendations given become material for revision of the developed learning media. At the implementation stage, the final version of the virtual garden application was implemented in learning the classification of living things by involving 44 students of class VII Junior High School. At the evaluate stage, the implementation of the process and the achievement of learning outcomes are evaluated as material for improvement and consideration of the implementation of learning by applying the virtual garden application.

In this study, there are two forms of data. First, the data from a review of the virtual garden application by learning media and science experts was obtained through a learning media review sheet. The review sheet consists of several statement items that must be responded to closed (using a Likert scale with 5 levels) and open which includes several assessment indicators including: technical quality (ease of use, systematic presentation of material), media content (graphics, text and audio), and visual communication (proportion and composition of each component in the layout), and pedagogy (concept accuracy and conformity with learning objectives). Second, student responses regarding the use of virtual gardens in learning were obtained through a questionnaire (using a Likert scale with 5 levels). Aspects of the assessment include the quality of the media components (graphics, text and audio), harmonization (the proportion and composition of each component in the layout), and ease of use. In addition, there are two open-ended questions that ask students' impressions of the use of virtual gardens in science learning on the topic of classification of living things and strategies in learning the classification of living things using virtual gardens.

The research data were analyzed qualitatively descriptively using percentages. The data that was reviewed by experts was then converted with validation criteria to be converted into qualitative data (Table 1). Student response data regarding the use of virtual gardens in learning were analyzed descriptively.

Percentage	Category	Validity Description
80 – 100	Very Valid	Very good to use
60 – 79	Valid	Can be used with minor revisions
40 – 59	Sufficiently Valid	Can be used with moderate revision
20 – 39	Less Valid	Can be used with major revisions
0 – 21	Invalid	Cannot be used

Table 1. Learning Media Validation Criteria (Bani & Masruddin, 2021)

3. Results and Discussion

This research focuses on the development of interactive multimedia with the name virtual garden which is applied to online learning on the topic of classification of living things in the field of science/biology studies in grade VII of Junior High School students. The media to be developed is based on the basic competencies in the Science Curriculum for junior high schools in Indonesia, namely 3.2 (Classifying living things and objects based on observed characteristics) and 4.2 (Presenting the results of classifying living things and objects in the surrounding environment based on observed characteristics).

The development of the interactive virtual garden begins with the preparation of workflows and wireframes that look like those in Figures 1 and 2.

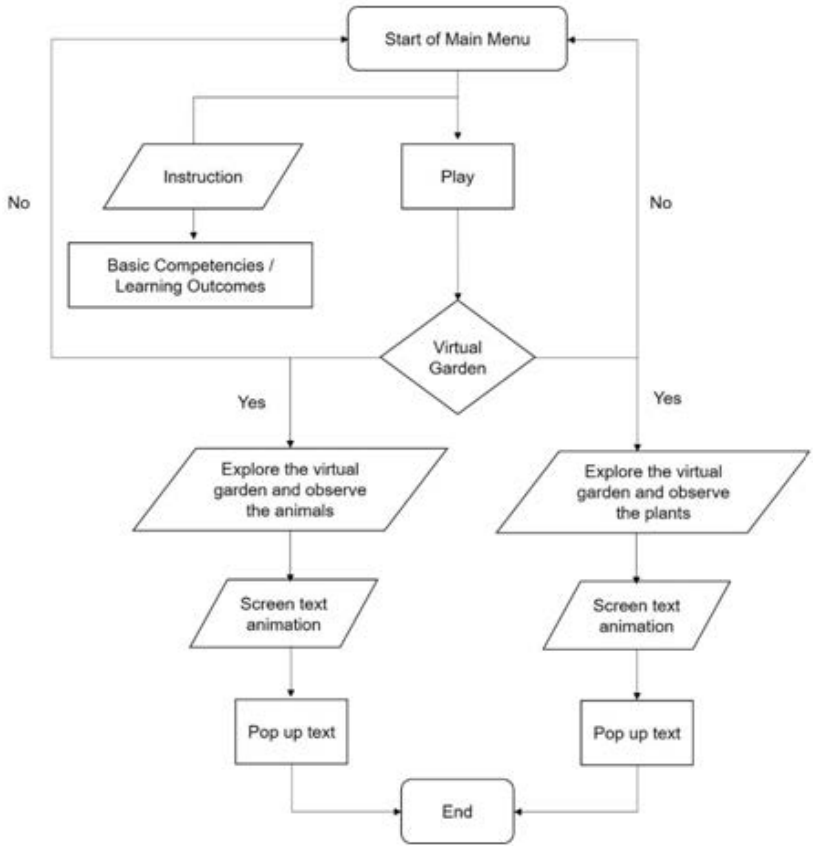


Figure 1. Workflow of Interactive Virtual Garden

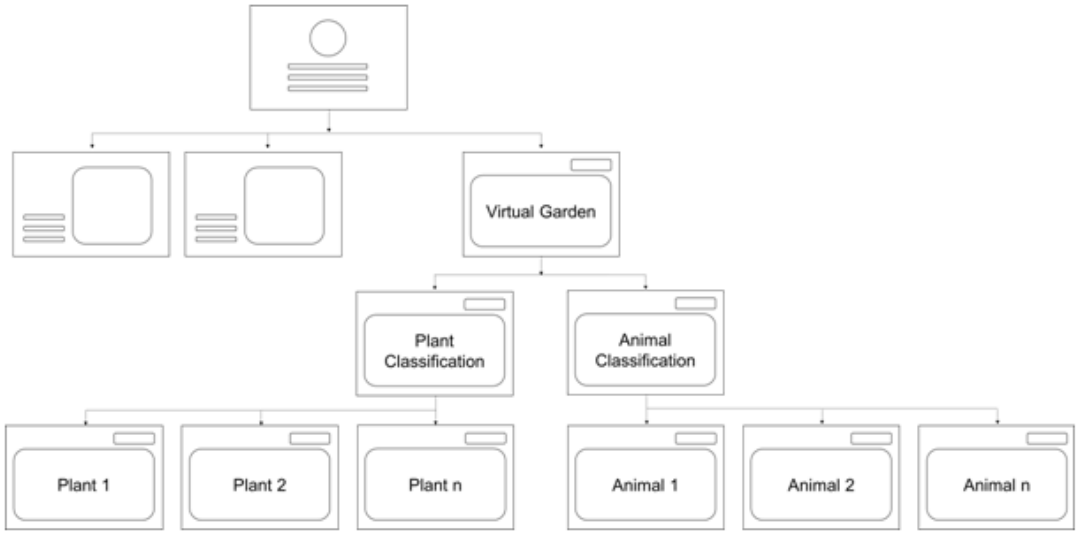


Figure 2. Wireframe of Interactive Virtual Garden

Based on the workflow and wireframe above, an interactive media based on virtual tour was developed with the name Virtual Garden which looks like in Figures 3 and 4.

Figure 3. Initial View of Virtual Garden

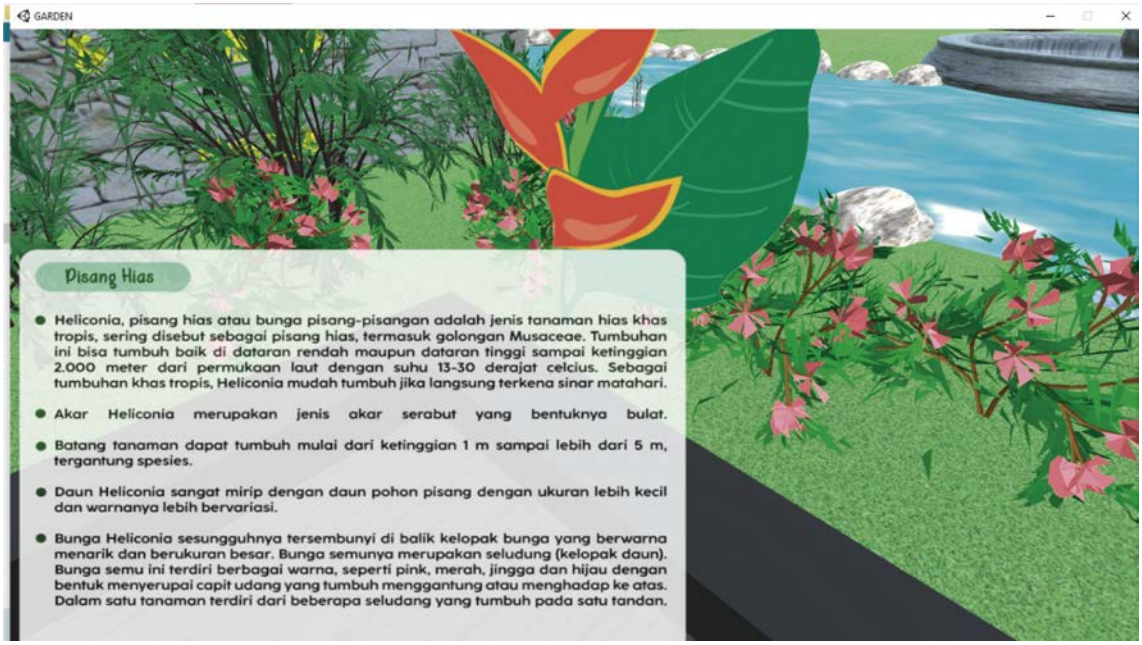


Figure 4. Virtual Garden Content Display

The virtual garden concept was inspired by the results of research by Bai (2020) who developed a virtual architecture landscape using Quest 3D software and Padmasari, Hariadi and Christyowidiasmoro (2020) who developed a virtual 3D batik gallery using Unity 3D. The virtual garden that was developed is designed to resemble the visual appearance of a garden that looks like a situation in the real world, consisting of various plants and several animals that interact in the garden environment. Information from every detail of the organism there will be presented, so that students can interact with the media through a computer monitor screen. According to Leow and Neo (2014), a good learning media is a media that is able to stimulate students to learn and can create a more interactive classroom environment.

In an effort to quality control the Virtual Garden application that was developed, validation was carried out by media, content and science learning experts. The following presents the results of the evaluation of the Virtual Garden.

Aspects of Assessment	Score	
	Media Expert	**Science Content & Learning Expert**
Technical	4.00	5.00
Media Content	4.00	-
Pedagogy	-	4.75
Visual Communication	4.00	4.83
Average score		4.43
Percentage (%)		88.6
Category	Very Valid	

Table 2. Virtual Garden Content and Media Validation Results

In general, the results of the assessment of the Virtual Garden show that this application is very valid to be used as a science learning medium on the topic of classification of living things. The validators rate this application very good and has very interesting illustrations. Completeness of original objects in the garden (garden) is also raised, such as rocks and water. Objects of plants and animals are also equipped with descriptions. The media validator suggests that further research can develop a mobile application version of Virtual Garden.

Classification of living things along with identification, description, and naming of living things is a study of taxonomy (Padial, Miralles, De la Riva & Vences, 2010). Taxonomy is taught at many levels, from elementary school to higher education. In elementary school, students learn that living things have some similarities and differences with one another, and that which has something in common can be grouped into one group. In junior high school, they study the external and internal structure of organisms as the basis for grouping and classifying. They also learn that species are defined as organisms that can produce fertile offspring from their mating. In high school, they learn that kinship can be seen from DNA sequences and understand complex classification systems. In higher education, taxonomy is increasingly detailed on the basis of classification based on morphological, anatomical, histological, and genetic characteristics (Kusumawardany, Muzzazinah & Ramli, 2019).

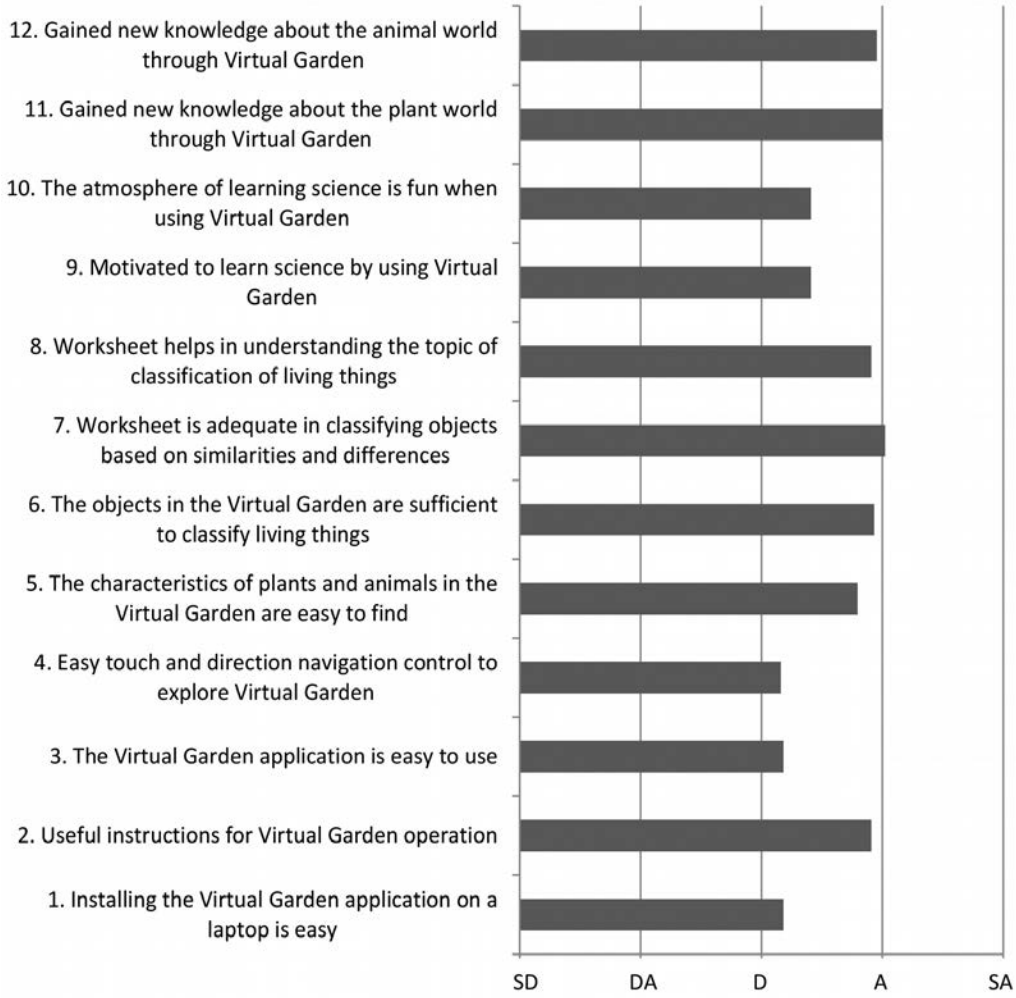
The Virtual Garden application can be an alternative media for learning the classification of living things. The Virtual Garden application can support learning the classification of living things because students can explore the garden as an artificial ecosystem and see 3D objects of various types of plants and animals equipped with a pop up description of each living thing, so that it can be information for students in determining the similarities and differences in plants and animals characteristics. In its implementation, the Virtual Garden application needs to be accompanied by a student worksheet that provides questions about the basics of grouping and simple determination keys. The use of this Virtual Garden application can add to the list of strategies and learning media applied to teach the classification of living things to high school students, as previously reported (Anđić et al., 2018; Rosenheck et al., 1989; Stagg & Donkin, 2015; Stagg et al., 2015).

The implementation of media that has never been used in learning will cause various responses from students, including the Virtual Garden application. In the following, data on student responses to the implementation of the Virtual Garden application in learning the classification of living things are presented (Figure 5).

Based on students' responses to open-ended questions, in general students gave a fairly good response to the ease of installation and operation of the Virtual Garden application and rated both the content and benefits of the Virtual Garden application. In addition, students become more motivated to learn science because they use interesting learning media. For some students, using Virtual Garden in learning is a new experience in learning a concept. Here are some students' impressions of Virtual Garden: learning the classification of living things is fun because it's like playing games (student 1, 11, 22, 25, 32); fun and new experience using Virtual Garden (student 4, 13, 26, 33); very helpful for better understanding the classification of living things (student 23, 24); very good because it can know the characteristics of living

things in more detail (student 19, 34, 36); very fun and easy to understand because there are very complete guides and characteristics of living creatures, but it's quite difficult when you want to open Virtual Garden, it's a bit difficult because my laptop doesn't support it (student 5, 15, 35); I really like using Virtual Garden, but when I use it the app doesn't run smoothly when I play it (student 8).

Learning media has an important role for teachers and is the key in creating interaction in the learning process (Hamilton-Jones & Vail, 2014). In operating the Virtual Garden application as a learning facility, students apply several different strategies according to group dynamics and supporting facilities during discussions. Some of them are as follows: walking slowly following the path then if there is a pop up stop then read and record it on the worksheet (student 1, 5, 20, 31); look for plants or animals as listed on the worksheet only (student 4, 7, 19, 33); screenshots of object images and descriptions of Virtual Garden for further study (student 2, 12); browse through everything in Virtual Garden and understand it (student 8, 18, 24); record info from plants/animals contained in the Virtual Garden (student 21, 23); and summarize important information in Virtual Garden (student 34, 36).



Description: SD = Strongly Disagree; DA = Disagree; D = Doubtful; A = Agree; SA = Strongly Agree

Figure 5. Student Responses to the Implementation of Virtual Garden Applications in Learning Classification of Living Things

To optimize learning using Virtual Garden in learning, there are several suggestions that need to be made, including (1) teachers need to take an inventory of the computers owned by students and their specifications, so that each group can work in groups optimally with computers that have adequate RAM

capacity; and (2) holding a pre-class to introduce how to operate the Virtual Garden application with touch navigation using a mousepad and directions using a keyboard before learning takes place.

4. Conclusions

Interactive multimedia in the form of a Virtual Garden application was developed using the ADDIE model. To design a Virtual Garden application, it begins with creating workflows and wireframes, creating 3D assets using Blender software, and producing Virtual Garden media with Unity-3D software and adding C# programming. The validator states that the Virtual Garden application is very valid to be used as a medium for learning science/biology on the topic of classification of living things.

Based on student responses, in general students gave a fairly good response to the ease of installation and operation of the Virtual Garden application and rated both the content and benefits of the Virtual Garden application.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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References

Anđić, B., Cvijetićanin, S., Maričić, M., & Stešević, D. (2018). The contribution of dichotomous keys to the quality of biological-botanical knowledge of eighth grade students, *Journal of Biological Education*, 9266, 1-17. https://doi.org/10.1080/00219266.2018.1469540

Bancroft, A. (2020). *Stony coral tissue loss disease: An environmental epidemic ravaging Grand Bahama marine protected areas*. Bahamas Natl. Trust. Available at: https://bnt.bs/news/stony-coral-tissue-loss-disease-sctld-an-environmental-epidemic-ravaging-grand-bahama-marine-protected-areas/ (Accessed: February 2021).

Bani, M., & Masruddin, M. (2021). Development of Android-based harmonic oscillation pocket book for senior high school students. *JOTSE: Journal of Technology and Science Education*, 11(1), 93-103. https://doi.org/10.3926/jotse.1051

Bai, X. (2020). Virtual garden landscape planning based on FPGA and GIS platform. *Microprocessors and Microsystems*, 79, 103314. https://doi.org/10.1016/j.micpro.2020.103314

Bebbington, A., & Council, F.S., (2005). The ability of A-level students to name plants. *Journal of Biological Education*, 39(2), 63-67. https://doi.org/10.1080/00219266.2005.9655963

Branch, R.M. (2009). *Instructional Design-The ADDIE Approach*. New York: Springer. https://doi.org/10.1007/978-0-387-09506-6

Brown, K. (2020). *The hidden toll of lockdown on rainforests*. BBC. Available at: https://www.bbc.com/future/article/20200518-why-lockdown-is-harmingthe-amazon-rainforest (Accessed: February 2021).

Girault, Y., Quertier, E., Fortin-Debart, C., & Maris, V.L. (2008). Éducation relative à l'environnement dans une perspective sociale d'écocitoyenneté. Réflexion autour de l'enseignement de la biodiversité. In Gardiès, A., Fabre, I., Ducamp, C., & Albe, V. (Eds.), *Education à L'information et Éducation aux Sciences: Quelles Formes Scolaires? Rencontres Toulouse EducAgro'08* (87-120). France: Publisher Cépaduès.

Girault, Y., & Alpe, Y. (2011). La biodiversité, un concept hybride entre science et gouvernance. In Legardez, A., & Simonneaux, L. (Eds.), *Développement durable et autres questions d'actualité. Questions socialement vives dans l'enseignement et la formation* (383-401). Dijon, France: Éducagri Éditions. https://doi.org/10.3917/edagri.legar.2011.01.0383

Girault, Y., & Sauvé, L.L. (2008). L'éducation scientifique, l'éducation à l'environnement et l'éducation pour le développement durable. Croisements, enjeux et mouvances. *Aster*, 46, 7-30. https://doi.org/10.4267/2042/20028

Hamilton-Jones, B.M., & Vail, C.O. (2014). Preparing special educators for collaboration in the classroom: Pre-service teachers' beliefs and perspectives. *International Journal of Special Education*, 29(1), 76-86.

Jacquemart, A.L., Lhoir, P., Binard, F., & Descamps, C. (2016) An Interactive Multimedia Dichotomous Key for Teaching Plant Identification. *Journal of Biological Education*, 50(4), 442-451. https://doi.org/10.1080/00219266.2016.1150870

Kartiko, I., Kavakli, M., & Cheng, K. (2010). Learning science in a virtual reality application: The impacts of animated-virtual actors' visual complexity. *Computers & Education*, 55(2), 881-891. https://doi.org/10.1016/j.compedu.2010.03.019

Kusumawardany, W., Muzzazinah, & Ramli, M. (2019, December). Plant taxonomy learning and research: A systematics review. *AIP Conference Proceedings,* 2194(1), 020051. https://doi.org/10.1063/1.5139783

Legardez, A., & Simonneaux, L. (Eds.) (2006). *L'école à L'épreuve de L'actualité: Enseigner les Questions Vives.* Paris, France: ESF Editeur.

Leow, F.T., & Neo, M. (2014). Interactive multimedia learning: Innovating classroom education in a Malaysian university. *Turkish Online Journal of Educational Technology-TOJET*, 13(2), 99-110.

Ma'ia'i, L. (2020). *Boom time for New Zealand's rats as lockdown gives them free rein in cities.* The Guardian. Available at: https://www.theguardian.com/environment/2020/apr/18/boom-time-for-new-zealands-rats-as-lockdown-gives-them-free-rein-in-cities-aoe (Accessed: February 2021).

Maskour, L., Alami, A., Zaki, M., & Agorram, B. (2019). Plant classification knowledge and misconceptions among university students in morocco. *Education sciences*, 9(1), 48. https://doi.org/10.3390/educsci9010048

Moulds, J. (2020). *5 ways the coronavirus is affecting animals around the world*. World Econ. Forum. Available at: https://www.weforum.org/agenda/2020/04/coronavirus-animals-wildlife-biodiversity-tiger-boar-pandas-zoos/ (Accessed: February 2021).

Padial, J.M., Miralles, A., De la Riva, I., & Vences, M. (2010). The integrative future of taxonomy. *Frontiers in zoology*, 7(1), 1-14. https://doi.org/10.1186/1742-9994-7-16

Padmasari, A.C., Hariadi, M., & Christyowidiasmoro, C. (2020). Hand motion tracking based on gesture understanding using leap gesture for virtual 3D batik gallery. *Journal of Physics: Conference Series,* 1469(1), 012099.

Pearson, R.M., Sievers, M., McClure, E.C., Turschwell, M.P., & Connolly, R.M. (2020). COVID-19 recovery can benefit biodiversity. *Science*, 368(6493), 838-839. https://doi.org/10.1126/science.abc1430

Rosenheck, M.B., Levin, M.E., & Levin, J.R. (1989). Learning botany concepts mnemonically: seeing the forest and the trees. *Journal of Educational Psychology*, 81(2), 196-203. https://doi.org/10.1037/0022-0663.81.2.196

Sahronih, S., Purwanto, A., & Sumantri, M.S. (2019). The effect of interactive learning media on students' science learning outcomes. In *Proceedings of the 2019 7th International Conference on Information and Education Technology* (20-24). https://doi.org/10.1145/3323771.3323797

Sauvé, L. (1996). Environmental Education and Sustainable Development: A Further Appraisal. *Canadian Journal of Environmental Education*, 1, 7-34.

Stagg, B.C., & Donkin, M.E. (2015). Mnemonics are an effective tool for adult beginners learning plant identification. *Journal of Biological Education*, 50(1), 24-40. https://doi.org/10.1080/00219266.2014.1000360

Stagg, B.C., Donkin, M.E., & Smith, A.M. (2015). Bryophytes for Beginners : The usability of a printed dichotomous key versus a multi-access computer-based key for bryophyte identification. *Journal of Biological Education*, 49(3), 274-287. https://doi.org/10.1080/00219266.2014.934900

UNESCO (2012). *Education for sustainable development; good practices in addressing biodiversity.* Available at: https://unesdoc.unesco.org/ark:/48223/pf0000220307 (Accessed: February 2021).

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