The use of 3D software on plant anatomy courses for prospective Biology teachers

The use of 3D software on plant anatomy courses for prospective Biology teachers

P K Suprapto[1], D M Chaidir[1] and R Ardiansyah[1]

[1]Biology Education, Universitas Siliwangi, Tasikmalaya, Indonesia

Corresponding author: purwatik1@gmail.com

Abstract. The use of computer-based learning media is something that is commonly done in the era of the revolution industry 4.0 today. The aim of this research is to describe the results of three-dimensional images created using 3D Blender. The research method used is a descriptive research. the collected data of the results of the assessment of the creation of the three-dimensional tissue form in plants. The criteria created by students are viewed based on form, cell details, size, differentiation, layout and caption. The population in this study are prospective Biology teachers who took the courses of plant anatomy in the academic year 2018/2019 in Biology Education department, One of the universities in East Priangan, Indonesia. Sample research used only one class with sampling technique is purposive sampling, regarding their homogenous sampling of having the relatively same ability and enough computer specification. The results showed an average of the 3-dimensional form of the assessment made on the ground tissues (2.84), tissue vessels (2.68) and dermal tissues (3.32). The average value obtained by prospective Biology teachers tends to be low, it is due to lack of mastery of the concept and at least the time for training software use.
Keywords: *blender, plant anatomy, prospective teachers*

1. Introduction

The use of computer-based learning media is something that is commonly done in the era of the revolution industry 4.0 today. As a prospective Biology teachers, it is very important to master the technology that can be used in very abundant learning today. Integrating technology into teaching is an important focus for teacher educators especially in this revolution industry 4.0 era, when technology dominates our lives and work. It is well recognized that information and communication technologies (ICT) have great potential for improving the teaching learning process [1]. With enough technology mastery, advances in educational technology focused on inquiry-based science learning reform efforts and refinement in instructional practices all present challenges and opportunities for science teaching [2]. Thus, the use of appropriate technology in the development of biology can develop the ability of prospective biological teachers.

One of the appropriate media in biological learning is 3-dimensional media. Because using the 3-dimensional media of prospective Biology teachers can represent the relevant observation results according to the original object [3]. Therefore, not only was the integration of technology and an innovative model a way to develop science pre-service teachers' knowledge, it was also a good teaching strategy for promoting the utilization of instructional technology in teaching for prospective science teachers [4]. In addition to the more relevant results, with the use of 3-dimensional media, prospective students will be easier to remember and understand the shape of various structures in

biology is quite abstract. In the process of workmanship students are required to first understand the context of the 2-dimensional form and then form objects in 3 dimensions [5]. In addition, it also mastery technology for aspiring science teachers, especially biology.

Many computer applications are created in developing a 3-dimensional form on learning biology especially plant anatomy. Among them 3Ds Max, AutoCAD, ZBrush, 3D Maya, Google Sketchup, and 3D Blender. Of these applications are mostly paid and require high computer specifications, so in this research application that can in making a 3D form in the learning of plant anatomy is Blender. Blender is one of three-dimensional application that is open-source, freely available, and cross-platform 3D software so that anyone can develop and use it for free [5]-[7]. Objects are given a surface appearance by the use of material shaders and textures. These two elements define the behavior of the surface when illuminated, by specifying local information like color, reflectance (dull or shiny) and microstructure (roughness or smoothness) [8]. This is because 3D software can utilize pictorial cues such as linear perspective, shading, and texture gradient to recover 3D structure from 2D images [9].

Prospective teachers should master the use of one of the 3-dimensional software, because in the usual learning process using 3D applications has the result of better cognitive ability to be compared with the use of traditional media [10]. In addition, using 3D media as a teacher can later introduce students how to learn using 3D software. However, it takes care to choose the object, and should be able to make students more interested in the use of 3D software that can provide benefits in the future [11], [12].

The aim of this research is to describe the results of three-dimensional images created using 3D Blender. The 3D form is the result of a prospective teacher in representation 3D object in the course of plant anatomy.

2. Research method

2.1. Participants

The research method used is a descriptive research. The collected data of the results of the assessment of the creation of the three-dimensional tissue form in plants created using the 3D Blender software. 3-dimensional form criteria created by students are viewed based on form, cell details, size, differentiation, layout and caption. The population in this study are prospective Biology teachers teachers who contracted the courses of plant anatomy in the academic year 2018/2019 as many as 3 classes in Biology Education department, in the one of university in East Priangan, West Java, Indonesia. Sample research used only one class with sampling technique is purposive sampling, regarding their homogenous sampling of having the relatively same ability and enough computer specification.

2.2. Instrument Test and Procedure

The instruments used in this research are test of 3D drawings created by prospective Biology teachers by using 3D applications/blender. With some assessments such as shapes, showing details of the cell form, size, showing differentiation, observing the layout, and caption of the image [13]. The rating scale made is 1-10 scale.

The research procedure begins with material giving activities to students of biological teachers about tissues in plants, namely basic tissues, dermal tissue and vascular tissues. After that, practice activities with the direct observation of fresh preparations and students depict the results of the observation directly. After describing in 2D students are asked to do also 3D images based on the 2D image and the last students are asked to create it using the software 3D Blender.

3. Results and Discussion

3.1 The Results

Prospective students can create 3D forms using blender application because the blender application is lightweight enough to be used with standard computer specifications, as long as the objects are made not too many, as well as usually only long during the rendering process, where in the process is based on the result of the initial environment setting in the blender. Blender also proved effective in the representation of biology as in the shell of gastropods [14]. While in the manufacture of microscopic representation on the plant anatomy material made look like in the following image.

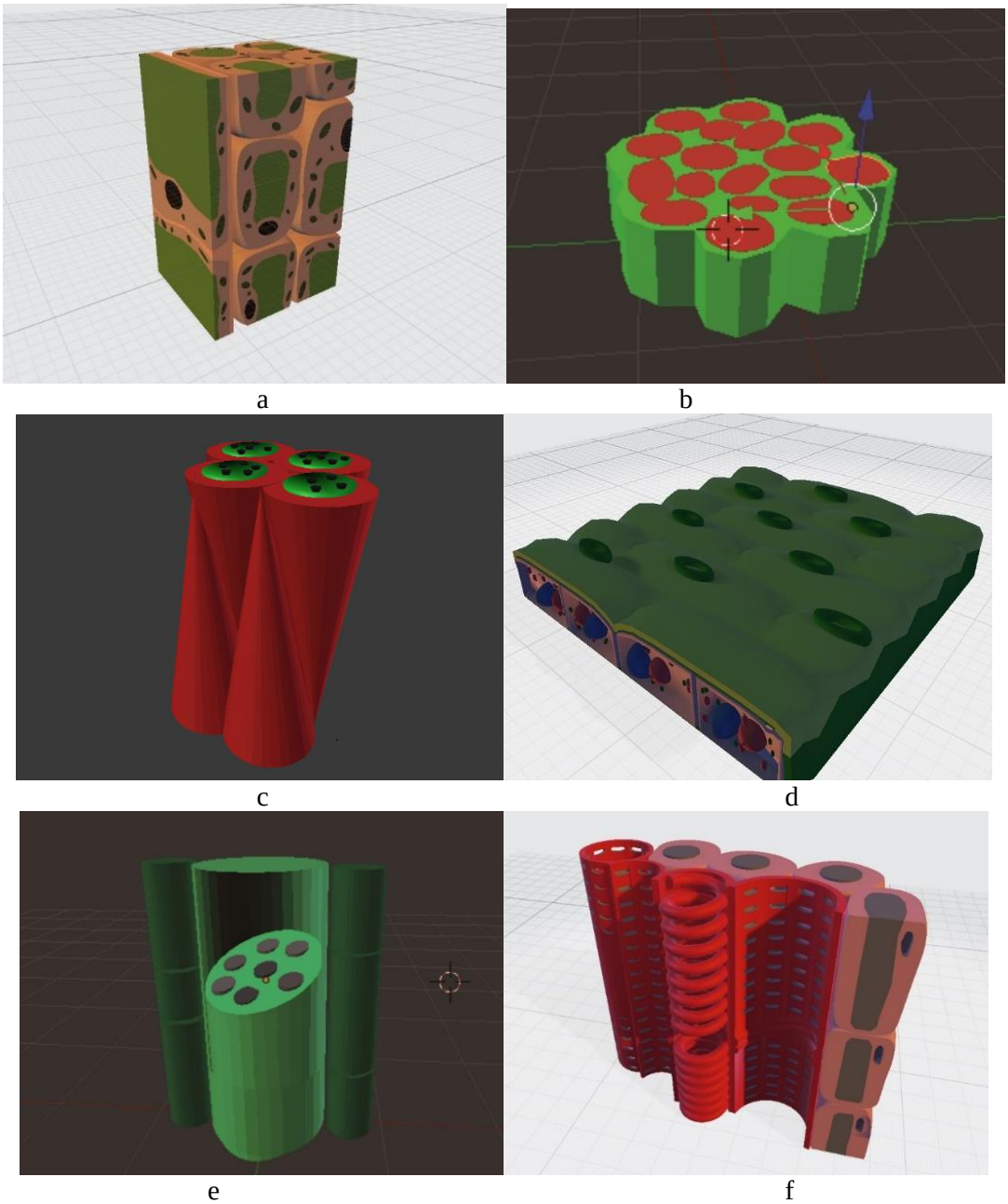

Figure 1. Examples of 3D picture making by prospective Biology teachers: parenchyma (a), collenchyma (b) sclerenchyma (c) epidermis (d) phloem (e) xylem (f).

The results of the study showed that the scores of images obtained by prospective biological teachers by using 3D Blender software tend to be low, as shown in the following table.

Table 1. Average score results images

No	Kind of Tissue	Criteria (score)						Average
		1	2	3	4	5	6	
1	Ground tissue							
	a. Parenchyma tissue	3.17	2.90	2.80	2.93	2.47	1.07	
	b. Collenchyma tissue	3.47	3.20	3.17	3.17	2.47	1.13	2.84
	c. Sclerenchyma tissue	3.90	3.50	3.73	3.00	3.80	1.37	
2	Dermal tissue							
	Epidermis tissue	3.47	3.07	3.13	2.93	2.60	0.87	2.68
3	Vascular tissue							
	a. Xylem	4.17	3.67	3.80	3.77	3.07	1.63	3.32
	b. Phloem	4.13	3.97	3.47	3.53	3.40	1.27	
Average		3.72	3.39	3.35	3.22	2.97	1.22	2.95

Description: 1) shapes, 2) showing details of the cell form, 3) size, 4) showing differentiation, 5) observing the layout, and 6) caption of the image

3.2 Discussion

Based on table 1, the lowest picture obtained by the student is the picture of Parenchyma tissue, because the students are still many who make the tissue in the form of cylinders of the same size, when the original form of the Parenchyma tissue is not thus a polyhedral-shaped [15]. While the highest value is obtained in the tissue group (xylem and phloem) it is because some criteria of 3D works made somewhat closer to the criteria that have been determined.

The score in table 1 shows the highest score on the number 1, which is the form of the network, the average score indicates 3.72. This is because the form of network created by the student has begun to resemble the actual network form although still in the low category. While the lowest score found in the image caption indicates a number 1.22 indicating low results, it is because many students will not give a description of the 3-dimensional image made.

The overall results of the study showed that images created by students of biological teachers tend to be low. It can be seen from the average value on the table for the base spoof (2.84), the dermal network 2.68 and the network of vessels 3.32 as well as the overall average of only 2.95 which shows a low average value. The cause factor is still a lack of understanding of students about the basic structure of tissue in plants and the use of 3D software blender.

The need for training and collaboration of various experts, especially in the use of 3D media outside the classroom hours, so that students can focus more on shaping the 3D structure of the plant's Anatomy. Concept understanding also needs to be improved in order to integrate with its technology mastery, because for now it is necessary to increase the mastery of technology use for prospective teachers[1], [16]. The need for the use of technology is also based on the need as a teacher who should be able to adapt to the needs of the current students [17].

4. Conclusion

The use of 3D software on courses of plant anatomy is effective enough, because students can learn also using useful technology for its future, although the scores gained in creating plant tissue with Using 3D software in the form of Blender get a low average score. The use of blender is highly recommended for the beginners because of its open source nature and does not require high computer specifications in working on the 3D form in the process of maintaining adequate training needed to be more Easily in forming the desired object. Therefore, it is necessary to training and synergetic with experts in the field of 3D software in order to be able to train more deeply for students of biological teachers in the use of such media.

References

[1] Yerdelen-Damar S, Boz Y and Aydın-Günbatar S 2017 *J. Sci. Educ. Tech.* **26** 394–405 https://doi.org/10.1007/s10956-017-9687-z
[2] Pringle R M, Dawson K and Ritzhaupt A D 2015 *J. Sci. Educ. Tech.* **24** 648–662 https://doi.org/10.1007/s10956-015-9553-9
[3] de Schlichting E, Robert Y, Selek L, Palombi O and Chaffanjon P 2015 *Surg. Radiol. Anat.* **37** 199–204 https://doi.org/10.1007/s00276-014-1362-y
[4] Jang S J and Chen K C 2010 *J. Sci. Educ. Tech.* **19** 553–564 https://doi.org/10.1007/s10956-010-9222-y
[5] Suprapto P K, Suharsono, Chaidir D M and Ali M 2019 *Proc. ISSE (Yogyakarta)* vol 1233 (Bristol: IOP Publishing) p 012002 https://doi.org/10.1088/1742-6596/1233/1/012002
[6] Waldon S M, Thompson P M, Hahn P J and Taylor R M 2014 *BMC Bioinformatics* **15** 1–18 https://doi.org/10.1186/1471-2105-15-334
[7] Garwood R and Dunlop J 2014 *J. Paleontol.* **88** 735–746 https://doi.org/10.1666/13-088
[8] Andrei R M *et al.* 2012 *BMC Bioinformatics* **13** S16 https://doi.org/10.1186/1471-2105-13-S4-S16
[9] Taya S and Sato M 2018 *Sci. Rep.* **8** 1–10 https://doi.org/10.1038/s41598-018-29361-2
[10] Hsiung L Y and Lai M H 2013 *Turkish Online J. Educ. Tech.* **12** 91–106
[11] Novak E and Wisdom S 2018 *J. Sci. Educ. Tech.* **27** 412–432 https://doi.org/10.1007/s10956-018-9733-5
[12] Chen S *et al.* 2017 *Sci. Rep.* **7** 1–11 https://doi.org/10.1038/s41598-017-00647-1
[13] Starko A J 1995 *Creativity in the Classroom: School of Curious Deligh 3rd ed.* (New Jersey: Lawrence Erlbaum Associates, Inc. Pub) pp 205
[14] Liew T S and Schilthuizen M 2016 *PLoS One* **11** 1–25 https://doi.org/10.1371/journal.pone.0157069
[15] Evert R F 2006 *Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function, and Development 3rd Edition* (New Jersey: John Wiley & Sons, Inc) pp 194
[16] Rehmat A P and Bailey J M 2014 *J. Sci. Educ. Tech.* **23** 744–755 https://doi.org/10.1007/s10956-014-9507-7
[17] Nicolas S 2018 *Int. J. Arts Sci.* **11** 425–440

Acknowledgments

We gratefully thank to the Institute of Research and Community Service (LPPM) of Universitas Siliwangi, because this research was financially supported by a research grant (International Journal-based Research). Thank you also to the Botanical Laboratory, Asep Yudi S. Helped researchers in completing this research.