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Designing Computer-Assisted Instruction for the Elementary Schools' Teachers of Merauke District, Papua, Indonesia

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Abstract Learning is a process that needs hardwork and sometimes makes students frustrated and get bored. In this context, the use of computers as media in teaching-learning process is of important to attract students' attention and to make teaching-learning activities more effective and enjoyable. This study aimed at designing computer-assisted instruction of high-level plant anatomy to support the 5th grade of elementary schools students' learning outcomes. To design the model, we employed a qualitative approach using developmental research design. Results of this present study are follows: [a] computer-assisted instruction of the structures of monocot (monocotyledon) and dicot (dicotyledon) plants; (b) computer-assisted instruction of the tissues' function of monocot (monocotyledon) and dicot (dicotyledon) plants. Since the use of computers in teaching-learning process is still lack in Merauke context, the results of this present study might be also worthwhile for the Head of Education Office at government level to provide LCD projectors for schools to promote the use of computer in teaching-learning process. The results of this present study might be imperative for the schools' principals to support teachers in designing computer-assisted instruction in order that students are motivated to enthusiastically learn all the subjects.

Keywords: *computer-assisted instruction, design, elementary schools, Merauke, teachers*

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1. Introduction

Learning is a process that needs hardwork and sometimes makes students frustrated and get bored in attending the lesson. In this context, the use of computers as media in teaching-learning process is of important to attract students' attention and to make teaching-learning activities more effective and enjoyable. At the time of visit, biology teachers of elementary schools in Merauke district seem to stay with the tradisional teaching-learning media, such as chalkboard and textbook as they are easily available in the school and user-friendly for teachers. Unfortunately, textbooks seem to be outdated when teachers encounter an immense problem in what learning materials must be delivered and how that learning materials must be presented to the pupils. This salient conditions motivate us to design a computer-assisted instruction with regards to tutorial model (Andrews as cited in [3]).

Variety of studies have been conducted on the topic of computer-assisted instruction [2,5,7,9,10,13,17,19,20,21,22,27,28], but still there is requiring lot of attention needed on the study of computer-instruction in Indonesian context, especially in Merauke district. Further, the absence of study on the topic of designing computer-assisted instruction in the Elementary Schools of Merauke district makes this study robust.

This study aimed at designing computer-assisted instruction to help teachers to easily deliver learning materials of high level plant anatomy to their pupils. To design computer-assisted instruction of high level plant anatomy, we employed a qualitative approach using developmental research design which we will briefly explain below.

2. Related Literature

2.1. Biology at Glance

Biology has been an integral and significant element of the Science and studied by all the students till the middle school level. Etymologically, the term biology derived from the Greek words 'bios' means 'life' and 'logos' means 'study of'. Based on the meaning of these two basic words, biology can be defined as a natural science concerned with the study of life and living organisms. Biolgy generally recognizes cell as the basic unit of life, genes as the basic unit of heredity, and evolution as the engine that prophels the synthesis and creation of new species [4].

Among others, the objectives of teaching biology at elementary schools are: (a) developing students'

knowledge and awareness of the environment, (b) helping students to have a meaningful and relevant knowledge in biology necessary for successful living in a scientific and technological world; and (c) creating room for students to deal with various technological advances. As it is concerned with all living things, biology has many branches, e.g.: (a) zoology: concerned with animals; (b) botany: concerned with plants; (c) cytology: concerned with cells; (d) ecology: concerned with the relationship amongst the living things and between the living this and their environment; (e) genetics: concerned with how feature is passed to offspring from their parents; (f) anatomy: concerned with the inner organs of living things; (g) microbiology: concerned with microscopic life; (h) taxnomy: concerned with the classification of living organism; (i) ornithology: concerned with the birds; (j) enthomology: concerned with insects; (k) parasithology: concerned with parasites; (l) bacteriology: concerned with bacteria; (m) mycology: concerned with fungi; (n) virology: concerned with viruses; (o) physiology: concerned with the function of tissue, organs and systems; (p) morphology: concerned with phenotype of living things; (q) embryology: concerned with the developmental patterns of organism from zygot to birth; and (r) neurobiology: concerned with nervous systems, including anatomy, physiology and pathology [4].

With the variety of branches, biology teachers are sometimes facing difficulties in teaching the such kind of concepts. Amongst many branches, in this present study we only focused on the effort of designing computer-assisted instruction of some high-level plants anatomy, which are: areacacea, musaceae, zingiber offcinale (monocot plants) and solanaceae, myrtaceae, moraceae (dicot plants). The following are the briefly explanation of each type of the stated plants [Merriam-Webster Dictionary, Wikipedia, and Encyclopedia Britanica].

a. Monocotyledon

- **Areacacea**

The arecaceae are a botanical family of perennial climbers, schrubs, acaules and trees, commonly known as palmae or palmaceae (although this name is still invalid). There are roughly 202 currently known genera with around 2600 species, most of which are restricted to tropical or subtropical climate area, such as Madagascar which has more endemic palms than the entire continental Africa and Columbia which has the highest number of palm species in one country.

- **Musaceae**

Musaceae is a family of flowering plants consisting of two genera (musa and ensete) with about 50 species native to the tropic of Africa, Asia and Australia, placed in the order zingiberales. Cultivated bananas are commercially important members of the family and many others are grown as ornamental plants.

- **Zingiber officinale**

Zingiber Offcinale (ginger) is a herbaceous perennial which grows annual stems about a meter tall bearing narrow green leaves and yellow flowers. Ginger originated to the tropical rainforest in Southern Asia. Although ginger no longer grows wild, it is thought to have originated on the Indian subcontinent because the ginger plants grown in India show the largest amount of genetic variation.

b. Dicotyledon

- **Solanaceae**

The name Solaneceae derives from the genus solanum, means 'the nighthade plant'. The solanaceae or nightshades or potato are an economicallu important family of flowering plants. The family ranges from annual and perennial herbs to vines, lianas, epiphytes, shrubs, and tress; and includes a number of important agricultural crops, medicinal plants, spices, weeds, and ornamentals. The solanaceae consists of 102 genera and nearly 2,500 species with a great diversity of habitats, morphology and ecology.

- **Myrtaceae**

Myrtaceae is a family of dicotuledonous plants placed within the order myrtales that characterized by numorous stamens, cymose flowers with inferior ovary, and opposite exstipulate leaves that yield a fragrant oil. All species are woody with the essential oils, and flower parts in multiple of four or five. Myrtaceae containing about 150 genera and 3,300 species that are widely distributed in the topics.

- **Moraceae**

Moraceae is a family of trees or shrubs placed within the order urticales that have a milky juice and small diclinous flowers with a one-celled ovary. Moraceae consists of about 40 genera and some 1,000 species of deciduous or evergreen trees and shrubs, distributed mostly in tropical and subtropical areas.

2.2. Computer-Assisted Instruction

There are variety of definitions about computer-assisted instruction. According to Encyclopedia Britanica [6], computer-assisted instructon is a program of instructional material presented by means of a computer or computers systems. Meanwhile Surjono [27] defined computer-assisted instruction as the use of computer as an aid in the teaching-learning process. Whereas Seo and Bryant [26] defined computer-assisted instruction as the use of a computer to provide instructional contents. Regardless of the various definitions of computer-assisted instruction, what is consistent in the literature is that the use of computer as a medium of instruction. Liao [15] asserted that the use of computer has long been developed as the part of the teaching-learning process. As Bork's ([1]: 34) prediction, "...by the year 2010 we can expect that the computer will on of the dominant educational delivery systems in many parts of the world", the use of computer as an instructional media has continued to grow rapidly.

There are various types of computer-assisted instruction. Lehman (n/d.) listed five categories of computer-assisted instruction as follows:

a. Drill and Practice

Drill and practice is exercises designed fluency in a new skill or body of knowledge or to refresh an existing skill or body of knowledge. Drill and practice assumes that the learners have previously been introduced to the content. Drill and practice is good for basic skills or knowledge where rapid student response is really desired.

b. Tutorial

Tutorials are used to introduce new content to students in much the same manner that a human teacher might.

Tutorials may be used in any area of the curriculum for: (a) remmediation when students lack necessary background knowledge; (b) enrichment when students wish to go beyond the basics; and (c) introduction of content to all students.

c. Simulation

Simulation is a form of computer-assisted instruction that provides a simplified representation of a real situation, phenomenon, or process. Simulation can mimic physical objects or phenomena, process, procedures, and situation. Simulation is good for sciences and other subject areas.

d. Instructional Game

Instructional game is another type of drill and practice or simulation that modified to include gaming elements. Features of instructional games are generally an end goal and rules of play, sensory appeal, and motivational elements such as competition, cooperation, challenges, and fantasy. Games can substitute for worksheets and exercises, as a reward, or, in some cases, to foster cooperation among students.

e. Problem Solving

Computer-assisted instruction that is designed to foster thinking or probem solving skills does not fit into one of the other categories. This approach usually focuses on a specific type of problem solving and provides pratice on a number or variety of problems.

As other media of instructions, the use of computer as medium of teaching has also advantages and disadvantages. Moats (n/d.) listed advantages of the use of computer-assisted instruction as follows: (a) more practice opportunities for skill development; (b) multi-modal presentation of information; (c) continuous feedback and reinforcement on responses; (d) increased efficiency – time on task, targetted difficulty: (e) privacy, self-pacing to avoid embarrassment; (f) cotrolled social media environment, peer feedback, chat, posting of message; and (g) choice of activities in a menu. Moats (n/d.) further listed generic disadvantages of computer-assisted instruction as follows: (a) in text reading, a sense of the whole is lost; (b) speech recognition software not advanced enough to support feedback; (c) corrective feedback is not necessarily relevant to the source of error; and (d) keyboarding may not always have an advantage over handwritten notes, responses, and drafts.

3. Method of the Study

To design computer-assisted instruction we employed a qualitative approach using developmental research design. Seels and Richey [25] defined development research as the systematic study of designing, developing and evaluating instructional program, processes and products that must meet the criteria of the internal consistency and effectiveness. Instructional technology has traditionally involved a unique blend of theory and practice which is most obvious in developmental research which involves the production of knowledge based upon situation-specific problem solving [23]. In the context of instructional technologies, Richey et al. [24] stated as follows:

In the field of instructional technology, development has a particular, somewhat unique, connotation. The most current definition views development as 'the process of translating the design specification into physical form' ([25], p. 35). In other words, it refers to the process of producing instructional materials (p. 1100).

The steps followed to design computer-assisted instruction materials for teaching high-level plants anatomy were to: (a) identify the problems faced by the 5th grade teachers when learning biology; (b) identify some concepts in high-level plants anatomy; (c) define general learning objective of the computer-assisted instruction lesson; (d) define specific learning objective of the computer-assisted instruction lesson; (e) design computer-assisted instruction program; and (f) make the materials of instruction available online for the 5th grade elementary schools' teachers of Merauke district [3,27].

To try out the model, we purposively selected 5 of the 5th elementary schools' teachers of Merauke district to participate in the study. The subjects of the study are seletected based on their familiarity in using computer as an educational tool of teaching.

4. Results of the Study

The first step in designing computer-assisted instruction was to identify the problems faced by the 5th grade teachers when teaching biology. We identified some major problems that cause ineffective teaching-learning process as follows: (a) students do not realy listen to the teacher when teaching biology; (b) students percept biology as the boring subject; (c) students' negative attitudes toward some biology topics, such as the structure and the tissues' function of both monocot and dicot plants.

The second step of this present study was to identify some concepts in high-level plants anatomy, such as [a] structure of monocot plants (areacaceae, musaceae, zingiber officinale) and of dicot plants (solanaceae, myrtaceae, moraceae); and [b] function of the tissues of mocot plants (areacaceae, musaceae, zingiber officinale) and of dicot plants (solanaceae, myrtaceae, moraceae).

The third and the fourth step of this present study were to define general and specific learning objectives of the computer-assisted instruction. General objective appeared in the introduction page of the lesson so that students could access it at the beginning of their session, while specific objective appeared at the beginning of each section throughout the lesson. The general objective of the computer-assisted instruction lesson was to help students learn basic anatomy of high-level plants. The specific objective were as follows:

Section 1: Structure of high-level plants

a. After completing section 1 the students will be able to state:
   - the structure of areacacea plants.
   - the structure of musaceae plants.
   - the structure of zingiber officinale plants.

b. After completing section one the students will be able to state:
   - the structure of solanaceae.
   - the structure of myrtaceae.
   - the structure of moraceae.

Section 2: Function of the tissues of high-level plants

After completing section 2 the students will be able to explain:

- the function of the roots.
- the function of the stems.
- the function of the leaves.
- the function of the seeds.
- the function of the flowers.

The fifth and the sixth step of this present study were to design computer-assisted instruction program and to make the materials of instruction available online for biology teachers and the 5th grade elementary schools' students of Merauke district as well. The computer-assisted instruction lesson is design to give the teachers, and the students as well, flexibility in controlling the sequence of the learning materials. Teachers and students are free to go forward, backward, or even skip easily to the menu. However, the first page of the lesson and the title page will automatically appear when the teachers and the students open the lesson (see Figure 1).

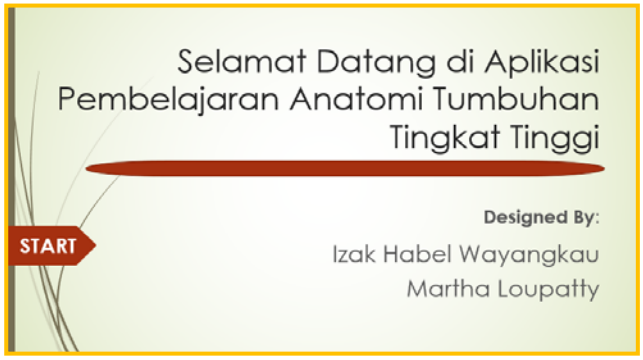

Figure 1. Title Page (Welcome Page)

To move from the welcome (title) page to next page, teachers and students must **click** on the 'Start' button available at the midle of the page. This button is assigned to the link behavior where the next page is the Main Menu page. Main Menu page is as reflected in Figure 2.

Figure 2. Main Menu Page

From the 'Main Menu' teachers or students as well can go to an 'Introduction Page' (by clicking button 'Pengantar') which contains information about the objectives of the lesson and some directions for the users (teachers and students). However, if the users (teachers and students) want to go directly to the menu 'learning materials' then they may click the button 'Materi'. The 'Learning Material' page is as reflected in Figure 3.

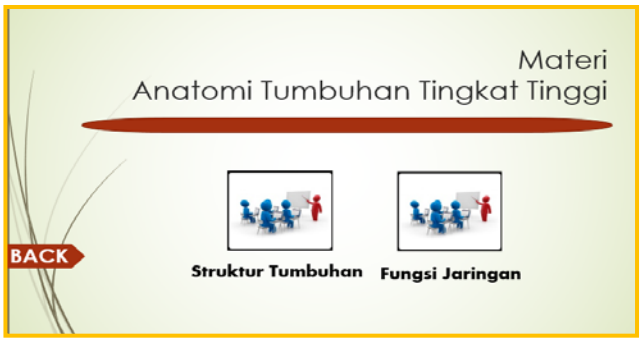

Figure 3. Learning Material Page

In this page, the users (teachers and/or students) can go to a learning materials of the structure of high-level plants (by clicking the button 'Struktur Tumbuhan') which contains information about the structure of monocot plants and of dicot plants (see Figure 4).

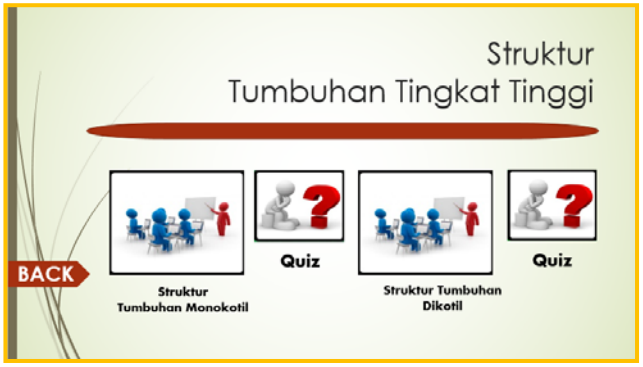

Figure 4. The Structure of High-Level Plants

However, if the users (teachers and students) want to deepening more on the function of the tissues of high-level plants then they can go directly by clicking the button Fungsi Jaringan (see Figure 5).

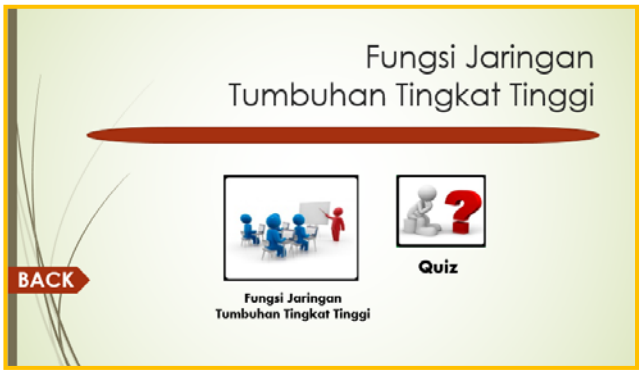

Figure 5. The Function of the Tissues of High-Level Plants

In this page, the users (teachers and students) can go to the function of tissues of high-level plants (by clicking the button Fungsi Jaringan Tumbuhan Tingkat Tinggi) which contains of information about the function of roots, stems, seeds, leaves, and flowers.

At the end of each material presentation, there is a button called Quis. By clicking this button the users (students) will advance to the first question. When the users (students) answer the first question, the next question will automatically apears and so on. Besides, there is also a BACK button in every page assign to the

previous page. By clicking this button the users (teachers and/or students) may go back to the previous pages.

5. Discussion

Learning is a process that needs hardwork and sometimes makes students frustrated and get bored in attending the lesson. In this context, the use of computers as media in teaching-learning process is of important to attract students' attention and to make teaching-learning activities more effective and enjoyable. Biology is a rapidly advance science with the huge amounts of information about the living organisms and environtments. The learning targets of the biology curriculum consists of three domains, namely: knowledge, skills, values and attitudes. In order to help students in achieving these three targets embodied in the Biology curriculum, teachers should find a teaching model that will make the content of high-level plants anatomy, with regards to the structures and functions of the tissue of high-level plants anatomy, more enjoyable and easily to understand.

Variety of studies [2,8,11,12,28] have proposed to employ computer-assisted as an education tool of teaching biology. This present study entitled 'Designing Computer-Assisted Instruction for the Elementary Schools' Teachers of Merauke District, Papua, Indonesia' have to be viewed as an effort of helping biology teachers of elementary schools to deliver teaching materials of high-level plants anatomy. When the model was tried out, the teachers who participated in this present study were attractive. They believed that this model would really come into practice in the hands of all the 5th grade elementary schools' teachers of Merauke district.

6. Conclusion, Implications, and Recommendations

This present study aimed at designing computer-assisted instruction to help teachers to easily deliver learning materials of high level plant anatomy to their pupils. The conclusion depicted from this present study is the lesson entitled 'High-Level Plants Anatomy' consisting of two main sections, namely: [a] structure of monocot plants (areacacea, musaceae, zingiber officinale) and of dicot plants (solanaceae, myrtaceae, moraceae); and [b] fuction of the tissues of monocot and dicot plants can now be accessed for teaching biology to the 5th grade elementary schools' students. Based on the model-trial results, in order to complete the computer-assisted learning lesson teachers might need a total time of about 4 to 6 hours, with an average of 2 hours for each section.

Practical implications of this present study are that: (a) the schools' principals are obliged to support teachers in designing computer-assisted instruction in order that students are motivated to enthusiastically learn all the subjects; and (b) since the use of computers in teaching-learning process is still lack in Merauke context, the results of this present study might be also worthwhile for the Head of Education Office at government level to provide LCD projectors for schools to promote the use of computer in teaching-learning process. Since the topic of this study is still absent in Merauke context, the result of this present study may theoretically add the existing literature on the topic of computer-assisted instruction in general and especially on the topic of designing computer-assisted instruction for helping teachers to deliver learning materials.

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Conflict of Interest

This paper has no conflict of interest.

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