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Visualization Program of Practical Work Manual for Biology Concepts on Health Education Topics

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Abstract

Science practical work has to be carried out with due regard to the availability of resources and has to facilitate student learning, but in accordance with the instructional goals. A practical work manual need to be supplemented with relevant visualization programs in order to improve students' understanding of practical work on health education topics. The objectives of the research were to identify practical topics that need visualization programs and to develop an example of a visualization program for the practical work. The results of the research were models of visualizing practical work procedures in biology on the topics of health education. The study carried out using the design of qualitative research method. The source of data and information consisted of five lecturers and sixteen students of the Biology Education Program. The instruments consisted of focus group discussion, interviews, document analyses, questionnaires, and test. The results indicated that practical works manual require programs to visualize practical instructions that students must undertake. The visualization programs are to provide a more detailed explanation of the components of the topic discussed, such as in the respiratory system, to provide a detailed description of the procedures that must be carried out, for example in practicums of measuring respiration rates, and to detail observations, for example in practicums of the sex determination of fruit flies. In addition, the results specified that in the development of programs that visualize practical instructions and biological concepts could use the Dick & Carey Systems Approach Model for Designing Instruction. The programs are to increase students' understanding of practical work and towards the content discussed. However, further researchs need to conduct in order to explore and analyze the level of student understanding.

Keywords: *Visualization, practical work, practicum manual, biology-concepts, health education topics.*

Introduction

The main objectives of practical work in biology, espeially on health education topicts, are: to teach science concepts, subject materials, and the nature of science; to develop skills and techniques for scientific procedures; to enhance scientific literacy; to increase motivation and interest; to develop social skills, and; to provide support in applying the knowledge in everyday.[1, 2,3]Practical skills among others, can be in the form of physical skills, such as measuring, observing, experimental design, data management, and other psychomotor skills; as well as the skills to think and use logic, such as making inferences, choosing appropriate method and identifying regularities of nature, and problem solving.[4] Concerning the types of activities, practical work that could be carried out, includes practical observation, experiment, and investigations.[5,6]

Practical work is still considered to face some problems in terms of task and activity characteristics, relevancy of assessment, implementation support, and adequacy of resources, time, and facilities.[7,8,9] Open and Distance Education copes with similar issues.[10,11] Improved learning outcomes in science, including biology concepts on health education topisc, can be achieved by: creating learning materials that are more concrete; placing learning materials in a realistic context;

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providing practical experience in the method of science and with scientific instruments; improving observation skills; fostering cooperation and roles in the team; developing a positive attitude about the outside world, and; gaining knowledge of the natural relationship with the community, especially with regard to the use of resources.[1]

In order to promote learning and understanding and to aid in analysis and problem solving in science, Vavra, *et.al* proposed recommendations for providing visualization objects, interpretive visualization, and animations and computer-based visualizations.[12] Scientific visual and visualizations include dynamic multimedia demonstrations of principles, animated explanations and manipulable three-dimensional images.[13,14] Vavra, *et.al* indicated that the visuals are used as a supplement to text, in addition animations are used to explain concepts that can't be seen, to explain movement, to figure three-dimension concepts.[12]

The Undergraduate Program of Biology Education at Universitas Terbuka (UT), the Open University in Indonesia, considered that the existing Practical Work Manual needed to supplement visual programs, especially in order to enhance student understanding in conducting practical work in health education topics. An alternative form of supplements is a visual of the explanation that describe and discuss in the Practical Manual. The visual program refers to the process of creating a graphical representation or is a synonym for visual imagery.[12]

The research problems consisted of (1) what are the topics of practical work procedures that most need visualization supplement, (2) what are the topics of practical work procedures that are most likely to be developed, (3) what are the steps required for program development, and (4) how do students perceive the visualization program. The objectives of the research were to identify practical topics that need visualization programs and to develop themodel of visualization program.

Reaseach Methodology: The research design was based on qualitative research method, and Research and Development (R & D).[15] Procedures of product development followed the Dick, Carey & Careymodel.[16]

The study carried out in Tangerang Selatan, Indonesia. The sources of information were 5 experts in biology education and 16 students of the biology education program who did practical work in. Data collection consisted of focus group discussion, interview, document analysis, a questionnaire and a test. Focus group discussions and interviews to experts and students were carried out in order to identify topics of practical work manuals that require visualization programs. The researchers developed visualization programs of respiration rate, fruit flies sex determination, and flower diagram model. The experts expressed their oppinion regarding content of the visualization programs. The students filled questionnaire, took the test and gave their oppinion reagrding the content and quality of the program and their understanding. Collected dataand information were analyzed descriptively.

Results and Discussion

The results of student focus group discussions and the results of experts' reviews indicated the practical work manual required additional visualization for the procedures, and additional explanation. Both the students and the experts determined that visualization was needed for the topics of: (1) measuring respiration; (2) osmosis and plasmolysis; (3) photosynthesis; (4) identification of bacteriaand fungi; (5) blood type examination, (6) reproductive system, (7) fruit flies sex determination, (8) microorganisms in life (e.g rhizopus, aspergilus), (9) desinfectants in environment, (10) diagrams of flowers, and (11) motion of heart tendons.

The results showed generally that practical work that needs lab equipment and the guidance of the instructor requires additional explanation or visualization. Some practical work was considered to be able to be simulated through a drylab program. The experts recognized the most suitable practical work that could be substituted with simulation programs. However, the students argued that they have to do all the practical work and thus they recommended that it not only be demonstrated through simulation. Furthermore, the practical work topics of frog cardiac muscle motion, and determining male and female fruit flies could be given to students as simulations (drylab program).

Development of visualization programs follow the procedures of the Dick, Carey & Careymodel.[16]The initial idea of the study was to consider the need for other media provided to clarify the practical procedures listed in the Manual of practical work in biology. Students and experts have reviewed and analyzed the topics that required additional explanation.

The prototype consisted of a visualization program in the form of an interactive power point. In order to improve the programs, through a Focus Group Discussion, five experts assessed the prototype visualization programs. The expert assessment indicated that the program neededrevision, especially for (1) instruction, illustration, and proceduresof measuring animal respiration program, (2) illustration, feedback, and discussionof fluit flies sexdetermination program; and (3) images and consistency of terms for flowerformulas anddiagram program.Results of the *one to oneevaluation* showed that the draft prototype needed to be refined in terms of procedures and explanations of the practical results and the assessment, especially for the topic of measuring respiration rate of animals, and the symmetry and formulas of flowers.

The next stage was to evaluate and try out the draft of prototype by a small group of nine students. Students' perceptions regarding the practical work of measuring respiration rates showed that program animation or simulation were insufficient to support their work in carrying out observations and writing reports. Content and display programs hadtorevise. Furthermore, students can conduct the practical work of determination of fruit flies sex. The content and appearance of the program is good enough so that the program does not need to revise. The students consider that animation program of the flowers diagrams had to revise, especially concerning the explanation of content and the images of program. Students stated that to providebetter, attractive, and natural photographs of flowers.

After reviewingthe practical work Manual and watching the program, students have had the test to measure their understanding of the practical work and the content. The analysis showed that the students have a good understanding of the procedures and content delivered via the visualization program practical work for determining fruit flies sex, and show sufficient understanding of the procedures and content of the practical work for animal respiration rate and flower diagrams.

Visualization is required to convey complex concepts or data, abstract concepts, interrelationships in a system, a scientific explanation that cannot be found in everyday life, and certain processes that occur at the microscopic level.[13,1,14]Conceptually, visualization can be visualization objects and introspective and interpretive visualizations. Thus, visualization can be physical objects, mental objects, and cognitive processes that involve the interpretation of physical or mental visualizations.[12]A visualization laboratory considers tosupport explain, develop and teach the concepts being studied. For example, clarification of practical procedures, clarification of how to manipulate the equipment, observation techniques and types of recording results. The visualization could be a representation or description of a process or activity or skill or results or object or shape of the image, and then the object can be image visualization, three-dimensional models, schematic diagrams, geometric illustrations, through computer modeling, simulation, animation, video.[13,1, 14, 12]

Program visualization of practical work becomes important for students who are learning in the open and distance education system. In this learning system, the learning process will run more smoothly and significantly when utilizing a variety of instructional media. In terms of practical activity, distance education learning tends to use a variety of technologies and media and it is an attempt to restructure the relationship of students with learning resources.[17]Distance education learning leads to the use of computer and computer -based learning.[18,19]The effects of computer simulations in science education are caused by interplay between the simulation, the nature of the content, the student and the teacher.[20]

In this research, the visualization program created as an additional explanation is not in the form of practical simulations or replacements. Kennepohl argued that the types of practical work for distance education systems could be both wet and dry lab practical work.[10] The type or form of practical work could be hands-on, simulation programs, remote labs, virtual labs, and real practical work (practical work in labs or the field).[1,2]

Indeed a visualization program is not a solution to everything. However, the effort and method to provide visualization are expected to enhance students' understanding, the quality of teaching, and student learning.[21]. A visualization program consider to enhance the students' understanding of practical work that ultimately mayimprove various things like understanding of concepts, problem-solving skills, scientific thinking habits, skills, attitudes, interests and motivation of students. In line with the opinion of Rundgren & Bao-jun[21], the determination of the visualization should be linked to the characteristics of the content and not give rise to misconceptions.

Conclusion

The visualization program for practical work is required in order to clarify the description in the practical work manual. The program would provide a more detailed explanation of the components of the topics discussed, for example in the practicum of the respiratory system, reproductive system, and flower diagrams. In addition, the programs could provide detailed description of the procedures, for instance in practicum of respiration rate, osmosis and plasmolysis, heart muscle motion. Furthermore, the programs could provide detail observations, on the case of practicums of bacteria and fungi identification and disinfectant levels in the environment. Development of visualization programs could use the Dick & Carey Systems Approach Model for Designing Instruction. The programs should be attractive and could facilitate student learning. Relevant studies are required to analyze the level of students' understanding by involving more students in the study.

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