The Development of Practical Work Instruction on Material of Regeneration and Pigmentation

Dwi Candra Setiawan[1], As'ad Syamsul Arifin [2,]
[1] Biology Education, IKIP Budi Utomo, Malang
e-mail: dwicandra14@gmail.com

Abstract

Practical work instruction is one of important teaching materials in the learning process, especially in the course that requires laboratory work. The existence of practical work instruction will really assist the students in carrying the lab work activity out. In addition, practical work instruction can also help lecturers in giving guidance during the practical activities so that the process of carrying the practical work out runs well. Based on the results of observation and personal experience of teaching teaching, some courses which include practical work do not have appropriate practical work instruction. This is why we need to develop practical work instruction on the observation process of regeneration and pigmentation of caudal fin of Zebrafish or Zebra Danio. The purpose of this research is to produce a good practical work instruction that is appropriate to be used by students especially in the course of animal development structure. The development of this practical work instruction used the development method of Thiagarajan which consists of define, design, develop and disseminate. However, in this research, we only proceeded until the develop stage. The object of this research was the students of IKIP Budi Utomo Malang, Biology Education Department who took the course of animal development structure. Based on the results of data analysis, we obtained that the practice manual was valid and appropriate to be used in practical work activities based on the evaluation criteria from the expert validation.

Keywords: *Practical Work Instruction, Thiagarajan*

1. INTRODUCTION

Conducting research in Indoneasia keeps increasing from year to year. The process of increasing the quantity of research in Indonesia is caused by the implementation of government program through *Kemenristek DIKTI* which obligates lecturers from both public college and private college to conduct at least one research per year. Of course, it will affect positively on the quality development of the lecturers.

The problem occurs when the lecturers finished conducting the research. One of the problems is the significance and the continuation of the results of the research. The research results should be able to be developed further to be benefitted better for both the researchers and the society. The research results can be developed to be particular product such as teaching material where through the development as a teaching material then the research can value more.

One research that is commonly conducted is the research on the process of regeneration and pigmentation. One of previous research was conducted to get model animal which could be appropriate to be used as the observation material of regeneration and pigmentation process. An example of the animals was Zebrafish (*Danio rerio*). This type of fish is commonly used to conduct research on the process of regeneration and pigmentation because it contains gen *slc24a5* which can also be found in human (Cheng, 2006 & 2008). In addition, the trait of Zebrafish which is benefitted as the model fish is the approach standard from the genetic aspect which has the potential to be applied on molecular mechanism, the fast fin regeneration process (approximately in two weeks), the easy procedure of cultivation in large quantity (Poss et al., 2003), and Zebrafish also has some biological controller gens which are similar to human's (Poss et al., 2002).

The result of research on the process of pigmentation during Zebrafish regeneration will be developed into teaching material in the form of practical work instruction for the course of Animal Development Structure. The arrangement of this practical work instruction was based on the college curriculum because this teaching material will be implemented on undergraduate level. Teaching material in this research was the practical work instruction which was one of printed teaching material category. According to Prastowo (2012), teaching material is all kinds of material either in the form of information, tool, or text which is organized systematically which presents the whole figure of competence which will be achieved by the students and used in the learning process for the objective of planning and analyzing the implementation of learning. The developed teaching material presents significant roles for either the teacher/lecturer or the students.

Based on the explanation of problems and solution proposed presented above, the researchers were interested in conducting a research entitled "Utilization of Pigmentation Process during Zebrafish (*Danio rerio*) Caudal Fin Regeneration Result as Practical Work Instruction for Animal Development Structure Course".

2. METHOD

This research was a developmental research where the development model used was Thiagarajan development model which consist of four stages: define, design, develop, and disseminate. However, this research was only conducted until the develop stage. The subject of this research was students of Class 2016 A at IKIP Budi Utomo Biology Education Study Program who took the course of Animal Development Structur. The class consisted of 40 students. The procedure of developing practical work instruction on animal development structure consisted of the following stages.

1. Define

Define is the beginning stage where the researchers examined the problems occurred during the learning process which was especially related to the use of practical work instruction by conducting direct observation and/or interview with the lecturer(s) of Animal Development course in the Biology Education Study Program at IKIP Budi Utomo.

In this stage, the researchers also did an analysis on the students' characteristic, basic competence that should be achieved by the students, the students' tendency on the learning media that was easily accessed by the students, and also the language mastered including the diction and language style preferred by the students. This stage also involved an analysis on both the material and concept appropriate to the course of animal development. The concept analysis was done by the researchers by referring to the syllabus of Animal Development course in Biology Education Study Program at IKIP Budi Utomo.

2. Design

Design was the second stage which was in the form of designing the practical work instruction. This stage was done by selecting the appropriate media and format of practical work instruction.

3. Develop

This stage was the last stage done in this research. In this stage, the researchers modified the practical work instruction based on the feedbacks from the experts' validation on the aspects of material, format, language, and media. The criteria of experts who were involved in the process of evaluation and validation of the practical work instruction were presented on Table 3.1.

Table 3.1 Criteria of Experts or Validators

No	Expert/Validator	Criteria
1.	Material expert	Lecture of Biology Education Study Program at IKIP Budi Utomo who has the competence and experience in teaching the course of Animal Development with Magister qualification
2.	Media expert	An expert who is able to design and apply various

		kinds of media
3.	Language expert	Lecturer of Indonesian Education Study Program at IKIP Budi Utomo

The instruments in collecting the data used in this research were as follow:

a. Response questionnaire for the students on the practical work instruction of Animal Development course
b. Material appropriateness validation instrument
c. Media appropriateness validation instrument
d. Language appropriateness validation instrument
e. Evaluation sheet for the experts'/validators' suggestion, critic, and opinion on the practical work instruction which was included at the end of each validation instrument.

The data analysis which was obtained through the evaluation sheet of validators' suggestion, critic, and opinion on the practical work instruction which was included at the end of each validation instrument was done in descriptive qualitative way and the results were used as the basis of the revision of the developed teaching book for the course of Animal Development.

The technique of data anylisis used to analyze the quantitative data which were in the form of material and media appropriateness validation scores was by coverting them into scale data in Table 3.2.

Table 3.2 Conversion of Actual Score to 4-Scale Score

Score Range	Category
3.51 – 4	Very good
2.51 – 3.50	Good
1.51 – 2.50	Fair
1.00 – 1.50	Poor

(Source: Adapted from Sudjana, 2005)

After obtaining the score conversion, it was continued by calculating the answers' percentage. The formula used was the percentage analysis technique according to Arikunto as follows:

$$P = \frac{\sum X}{\sum Xi} X\ 100\%$$

Note:
P : Validity percentage
∑X : Number of validator's answer in 1 item
∑Xi : Number of ideal answer in 1 item

The analysis of data which were in the form of percentage was then interpreted using qualitative sentence based on the criteria on Table 3.3.

Table 3.3 Criteria of Teaching Book Validation

Score range (100%)	Category
76-100	Valid
56-75	Valid enough
40-55	Less valid
<40	Invalid

(Source: Arikunto, 1993:210)

3. RESEARCH FINDINGS AND DISCUSSION

The development of regeneration and pigmentation material practicum manuals was conducted with thiagarajan development model. As a whole and the results of developing the lab manual:

1. Define

The early stage in this developmental research of practical work instruction was doing observation and interview with the lecturers of Animal Development course at IKIP Budi Utomo. Based on the results of observation and interview, it was obtained that in the experimental activities of Animal Development course was not equipped with an appropriate practical work instruction and there were many materials which were not able to be completed by doing experiment. In addition, by observing the process of Zebrafish caudal fin pigmentation then the lecturer could also give model animal alternative for the observation of the pigmentation process with some superior appeals of Zebrafish model animal such as: easy to get, affordable price, and long life endurance when they were observed under the microscope.

The researchers in the development of practical work instruction on the pigmentation process during regeneration referred to the determination of Basic Competence (General Instructional Objective) which had been decided before in arranging the syllabus of Animal Development course. Therefore, this practical work instruction development was not diverged from the topic and the determined Basic Competence. The Basic Competence used was to explain the process of regeneration and pigmentation on animal.

The analysis of Basic Competence was continued by describing the learning objectives and delimitation of materials which were related to the chosen Competence Standard and Basic Competence. This analysis of learning objectives was done to decide what learning objective which needed to be achieved in the process of practical work activity. After analyzing and determining the learning objective, the researchers arranged the *Satuan Acuan Perkuliahan* (SAP) or we can call it as Lesson Plan. After designing the lesson plan, the researchers developed the practical work instruction on the material of Regeneration and Pigmentation.

2. Design

In this stage, the researchers designed and developed the draft of practical work instruction which would be developed. The developed practical work instruction draft was matched to the appropriate materials in the syllabus for Animal Development course. This practical work instruction consisted of two big topics on the process of regeneration and process of pigmentation of Zebrafish as the model animal. In arranging the instruction, the researchers included theoretical background, tools and materials, and work procedure which used clear language and sentence so that it would ease the students to understand.

This practical work instruction was developed to help the students in developing their skill, concept understanding, and also learning motivation. Through the implementation of practical work activity which was equipped by practical work instruction which included the clear and detailed procedure or working guidance would indirectly develop the students' skill in doing laboratory activities.

Aside from developing the students' skill, this practical work instruction was also expected to be able to develop the students' concept understanding. This practical work instruction was completed with the theoretical background related to the practical work topic. Therefore, it would help the students in understanding the concept of materials learned by the students. In the stage of designing this practical work instruction, the researchers also designed the layout of this book. The layout consisted of the back cover design, front cover design, color selection, and picture selection for the covers.

3. Develop

The stage after design was develop where the draft for the practical work instruction had been prepared. This stage consisted of the process of validation from material expert and media expert and also langiage expert and reading test by the students.

a. Expert Validation

The try-out data in this stage were obtained from the results of validation on the practical work instruction which were done by three validators which consisted of two lecturers of Animal Development course as the experts of material, one lecturer from Indonesian Language Study Program as the expert of language, and one expert if media. The identity of the validators can be seen further in Appendix 7. The validators' evaluation data on the practical work instruction and validation sheet and also the response, critic, and suggestion from validators on the practical work instruction can be examined in Appendix 8. The summary of evaluation percentage of validation result by the college lecturers with their expertise on Animal Development Structure can be observed on Table 4.9.

a. Material Expert Validator

Table 4.9 Summary of Validation Result from Animal Development Material Experts

Expertise	Validator	Validation			
		Material and discussion	Learning Objective	Report and reference	Mean
Animal Development	**I**	84 %	96 %	93 %	91 %
Animal Development	**II**	77 %	100 %	93%	90 %
Mean		81 %	98 %	93%	92.5 %

Based on the summary of validation table above, the result of validator 1 was that the highest evaluation was on the component of learning objective as much as 96%. Meanwhile, the lowest score was on the component of material and discussion with achievement level of 81%. The mean of the evaluation level given by validator I was 91%. The followings were suggestions pointed by validator I as the expert of material.

1. It would be better if pictures of pigmentation and regeneration process were added to the theoretical background.
2. Data analysis in the report should be added to support the discussion.
3. The references that were easy to be accessed by the students should be increased.

Meanwhile, the validation results from validator II was that the highest evaluation was on the component of learning objectives as much as 100%. The lowest score was on the component of main material with achievement level of 82%. The mean of achievement level given by validator II was 92.5%. The suggestions presented by validator II were as follows:

1. The design for the instruction was interesting and appropriate to the topic, but the suitable pictures on the cover of the practical work instruction should be selected to match the topic.
2. The product was considered as appropriate to be used. However, the stages of regeneration process should be added.

Based on the results from the two validators, the appropriateness of the practical work instruction materials was considered as valid and appropriate to be used. For the detailed results of material expert validation can be seen on Appendix.

b. Language Expert Validator

Aside from having material expert validation, the development of practical work instruction on regeneration and pigmentation also went through language validation where this validation aimed at evaluating the appropriateness of the language and writing system. The language validation was done by Susandi, M.Pd. as the lecturer of Indonesia Language Department. The result of validation by the expert of language can be seen on Table 4.11 below.

Table 4.11 Summary of Validation Result from Language Result

Expertise	Validator	Validation		
		Cover	Content	Mean
expert of language	Languange	87.5 %	81.25 %	84.38%

Based on the above table, in general the mean of language use on the practical work instruction was 84.38%. Then, it can be said that from language aspect the practical work

instruction was considered as valid and appropriate to use. Several suggestions made by the validator was the need of revising the spelling and punctuation which was appropriate to *Ejaan Yang Disempurnakan* (EYD). Further detail of the validation results from media language expert can be observed on the appendix.

c. Learning Media Expert Validator

The development of practical work instruction of regeneration and pigmentation also involved media validation where it was validated by someone whose expertise was on Learning Media. He was Primadya Anantyarta, M.Pd. The results of the validation from Learning Media expert can be examined in the following Table 4.11

Table 4.11 Summary of Validation Results from Learning Media Expert

Expertise	Validator	Validation		
		Cover	Content	Mean
Learning Media	Learning Media	85 %	83.87 %	84.44%

The results of validation done by the validator from Learning Media field were the cover part of the practical work instruction received score 85% and for the content received 83.87%, while the mean of the results from media expert was 84.44%. The followings were the suggestions delivered by the media expert for the practical work instruction:

1. Design appeal: in general the practical work instruction was interesting, simple, and appropriate to the students.
2. Appropriateness of the practical work instruction: it was considered as appropriate to use and easy to be understood.
3. The superiorities of the practical work instruction: brief, compendious, and clear and also innovative in term of the practical work materials on animal development.

Based on those results above, the media of practical work instruction was considered as valid and appropriate to be used. Based on the presentation of data and data analysis on chapter IV, this chapter discussed about the reasons why this practical work instruction was important to develop. In composing this practical work instruction, the researchers always followed the standard or components which had to be included in practical work instruction. Arifin (1995) explained the components that which have to be included in pratical work instruction are practical work title, the objective of practical work, theoretical background, tools and materials, procedure, and questions. All of those components were completed in composing the developed practical work instruction.

The practical work instruction which was developed in this research was on the material of regeneration and pigmentation. In composing this practical work instruction, one of the important components was the arrangement of practical work instruction which had to be suitable to the learning objectives determined before. It was because the one of the objectives of arranging this practical work instruction was to assist the lecturers in achieving the learning objectives established. It was in line with the opinion of Purnamasari (2012) who explained that practical work instruction was designed to guide the students in doing practical work and aid the teachers to achieve the learning objectives. It also matched to the opinion of Trisnawati (2011) who said that practical work instruction was needed so that the activities of practical work runs well, the main objectives can be achieved, consists of work safety to minimize the accidental risks which possibly occurs, and etc.

Surianto (2012) explained that practical work activities cannot run smoothly and optimally was because the unavailability of practical work instruction. Based on the explanation, it was shown that practical work instruction was greatly needed for the learning process which included practical work. The practical work instruction will help the students in completing the practical work activities well and smoothly. Moreover, there was also the working procedure and all aspects needed during the practical work

occur in the practical work instruction. It will help the lecturers and students to achieve the learning objectives determined beforehand.

4. CONCLUSION

Based on the results of validation test and small-scaled try-out on the practical work instruction for the material of regeneration and pigmentation on Zebrafish caudal fin, it was concluded that this practical work instruction was appropriate to be used in the learning process

5. REFERENCES

Arifin, M. 1995. *Pengembangan Program Pengajaran Bidang Studi Kimia*. Surabaya: Airlangga University Press.

Cheng, K. C. and Canfield, V. A. The Role of *SLC24A5* In Skin Color. 2006. *Invest Dermatur.* **16**:836-838.

Cheng, K. C. 2008. Skin Color in Fish and Humans : Impact on Science and Society. *Zebrafish* **5**:2737-242.

[Depdiknas] Departemen Pendidikan Nasional. 2006. *Perangkat Pembelajaran Kurikulum Tingkat Satuan Pendidikan SD/MI, SMP/MTS dan SMA/MA*. Jakarta: Pusat Kurikulum.

Depdiknas. 2006. *Panduan Pengembangan Pembelajaran IPA Terpadu*, *SMP/MTs*. Jakarta: Pusat Kurikulum Balitbang Diknas. Tersedia di http://tedjo21.files.wordpress.com/2009/09/01-model-ipa-terpadu-smp.pdf [diakses pada tanggal 9 Mei 2016.]

Departemen Pendidikan Nasional. 2008. Pengembangan Bahan Ajar dan Media. Jakarta:departemen Pendidikan Nasional

Departemen Pendidikan Nasional. 2009. *Pengembangan Bahan Ajar*. (Online) (http://www.luk.staff.ugm.ac.id/atur/KTSP-SMP/11.PPT)Diakses Tanggal 9 Mei 2016.

Fang, F. 2000. Barred Danio Species from the Irrawaddy River Drainage (Teleostei, Cyprinidae). *Ichthyol. Res*. **47(1)**13-26.

Kelsh, R. N., Brand, M., Jiang, Y. J., Heisenberg, C. P. and Lin, S., Haffter, P., Odenthal, J., Mullins, M. C., Eeden, F. J. M. V., Seiki, M. F., Granato, M., Hammerschimidt, M., Kane, D. A., Warga, R. M., Beuchie, D., Vogelsang and Volhard, C. N. 1996. Zebrafish pigmentation mutations and the processes of neural crest development. *Development.* **123**:369–389.

Mills, M. G. and Patterson, L. B. 2008. Not just black and white: Pigment pattern development and evolution in vertebrates. *Development.* **849**.

Odenthal, J., Rossnagel, K., Haffter, P., Kelsh, R. N., Vogelsang, E., Brand, M., Eeden, F. J. M. V., Seiki, M. F., Granato, M., Hammerschimidt, M., Heisenberg, C. p., Jiang, Y. J., Kane, D. A., Mullins, M. C. and Volhard, C. N. (1996) Mutations affecting xanthophore pigmentation in the zebrafish, Danio rerio. *Development.*; **123**: 391–398.

Poss, K. D, Nechiporuk, A., Hillam, A. M., Johnson, S. L. and Keating MT. 2002. Mps1 d.efines a proximal blastemal proliferative compartment essential forzebrafish fin regeneration. *Development* **129**:5141-5149.

Poss, K. D., Keating, M. T. and Nechiporuk, A. Tales of Regeneration in Zebrafish. 2003.*Developmental Dynamics* **226**:202–210.

Purnamasari, Shinta. 2012. *Pengembangan Petunjuk Praktikum Kimia SMA Pada Pokok Bahasan Stoikiometri*. Skripsi. Bandung: Universitas Pendidikan Indonesia.. repository.upi.edu [diakses pada tanggal 26 April 2017]

Rawls, J. F., Mellgren, E. M. and Johnson SL. 2001.How the zebrafish gets its stripe. Development. **240**:301-314

Salirawati, D. 2001. *Materi Pelatihan Kepala Laboratorium Kimia bagi Guru-Guru Kimia Kabupaten Kulon Progo*. Disampaikan di Laboratorium FMIPA UNY Yogyakarta, 1 Oktober 2011..

Sudjana, N. 2005. *Penilaian Hasil Proses Belajar Mengajar*. Bandung: PT. Remaja Rosdakarya.

Sulistiani, S. N. 2013. *Pengaruh Penggunaan Buku Petunjuk Praktikum Kimia terhadap Minat Berpraktikum dan Prestasi Belajar Siswa Kelas VII SMP Ali Maksum Berdasarkan KTSP*. Skripsi. Yogyakarta: Universitas Islam Negeri Sunan Kalijaga. Tersedia di http://digilib.uin-suka.ac.id/7319/ [diakses pada tanggal 26 April 2017]

Surianto. 2012. *Pengembangan Buku Petunjuk Praktikum Kimia Kelas XI Semester Ganjil Berdasarkan Kurikulum Tingkat Satuan Pendidikan*. Tesis tidak diterbitkan. Medan: Universitas Negeri Medan

Thiagarajan, S., et al. 1974. *Instructional Development for training teacherof expectional Children. Minneapolis. Minnesota*. Leadership Training Institute/ Special Education. University of Minnesota.

Trisnawati, E. 2011. *Pengembangan Petunjuk Praktikum Biologi Materi Struktur Sel dan Jaringan Berbasis Empat Pilar Pendidikan*. Skripsi. Semarang: Universitas Negeri Semarang