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Development of audio visual learning media using mitochondrial DNA analysis of fruit fly from minahasa based saintific approach

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Abstract
Biology learning by utilizing local biodiversity is very impactful for students. The research has been done, to produce learning products in the form of audio-visual media analysis of mitochondrial fruit fly DNA (*Drosophila* sp.) from salak (*Salacca edulis* L.) in South Minahasa. This research applied development research method. The research stages are analysis, design, development, implementation and evaluation. The pilot phase of the audio-visual media product, through material content expert validation, learning media experts, design learning experts, and small group trials. Data about instructional media product resulted from questionnaire. The results of this research was expert material validation results 84% material valid. The results of validation of media experts is 82.8%, media quite good. The results of validation of design learning experts, 85% media feasible of use in learning. The result of student response test in small group obtained 88.6% thats means good response from the students.

Keywords: audio visual, learning, media, mitochondrial DNA, frut fly

Introduction
Local biodiversity that is endemic, very interesting used in biology learning. Utilization of local biodiversity, in learning will be closer to the students with the environment and stimulate students' creativity. Salak plants have long been cultivated in Pangu village, Southeast Minahasa. The problem faced by salak farmers, is the fruit fly. Fruit flies reduce the quality of bark, and can accelerate decay. This research utilizes fruit flies isolate from Salak, whose population is abundant, in biology learning in high school. Fruit flies isolates from Salak fruit used to mitochondrial DNA analysis.
Research conducted by Tsui and Treagust (2003) [14] shows that genetic material has many vocabularies and has a difficult concept for high school level learners. Whereas genetics is a material that information very quickly developed since the discovery of the structure of DNA by Watson and Crick (Booth and Garrett, 2004). Byrd m (2000) [4, 5] suggests that DNA structure is a difficult concept for learners to understand well, mainly due to the need for a strong understanding of chemistry. Research done by Haambokoma (2007), most high school students in Zambia have difficulty in studying genetics. The difficulties are caused by lack of appropriate tools or learning media. In addition, the learning of abstract genetic concepts is often taught by teachers through lecture method. Learning the concept of genes and DNA is more precisely taught, through experiments or using instructional media. It aims to visualize the characteristics of genes and DNA in order to be understandable to learners. Research conducted by Wurarah and Mokosuli (2016), 80% of teachers in North Sulawesi did not practice genetics, 55% of teachers have difficulty in explaining the concept of DNA to learners. Learning with a scientific approach should be able to build a systematic understanding of learners of a concept. Students will have difficulty in studying DNA (the object of abstract biological studies) if not through experimental activities.
Mitochondrial DNA analysis is selected, because the subject of DNA in high school is classified as difficult for students to understand and even teachers (Sumampouw et.al., 2016). Therefore, it takes a learning media that can more concrete the subject of DNA. DNA analysis requires modern equipment not yet available in schools. Besides using expensive chemicals. To solve this problem, mitochondrial DNA analysis of fruit flies at the Biology Laboratory of Manado State University and then developed into a biology learning media of DNA subject in high school. Besides being used in high school biology, DNA analysis of fruit flies is also useful for knowing the biodiversity of fruit flies in North Sulawesi.

Materials and Methods
Research Instrument
DNA analysis of fruit fly isolated from Sallaca edulis L, conducted at Molecular Biology Laboratory Department of Biology FMIPA Manado State University. Each stage of DNA analysis is recorded using a SONY handycam. Learning media are audio visual media (interactive video) DNA analysis of fruit fly experiment and DNA analysis point power. Learning media were created using the Camtasia 10.1.1 Program. Trial of learning media conducted on the students of class XII SMA Negeri 1 Ratahan Minahasa Regency.

Methods
1. Analysis DNA of Fruit Flies from Minahasa
Samples
Samples of fruit flies directly isolated from natural habitat, which is the location of the cultivation of Salak (*Sallaca edulis* L.) Village Ratahan, Souteast Minahasa, North Sulawesi Province, Indonesia. Furthermore, the cultivation of fruit flies in laboratory bioactivity and Molecular Biology

Department of Biology, State University of Manado. Population cultivation flies in the laboratory subsequently become a source of tissue for DNA analysis.

Extraction and Purification of DNA

Extraction and Purification of DNA is done according to protocol Blood and Tissue DNA Kit Geneiad. Protocol modifications made at the time of immersion of tissue with proteinase-K. DNA extraction, analyzed the purity and concentration on : A260 / A280 nm, using NanoPhotometer, Implan.

CO1 gene amplification, amplicon visualization and sekuensing

CO1 gene amplification was performed using the fruit fly Qiagen Rotor Gene. Amplification was performed using MyTagTM HS Red Mix Bioline (USA). PCR set up is 200 ng DNA templete, 1 mL primer LCO and HCO (Folmer *et al.* 1996), myTaq HS Red Mix 2x: 25 mL; ddH2O: up to 50 mL. PCR cyling condition: Initial denaturation 95^0 C, 1 minute; 95^0 C denaturation, 15 seconds; 90^0 C annealing, 15 seconds and Extension 72^0 C, 10 seconds. Amplicon visualization were using automatic electrophoresis qiaexel. Sequencing was performed using sequencing FIRST BASE Services Singapore. Output sequencing is accepted in the form of files seq. Sequence analysis using geneous Program 9.0. Alignment is done using Basic Local Alignment searcing Test (BLAST) on NCBI website (www.ncbi.com). Reconstruction of phylogeny using MEGA 7.0 program. Phylogeny tree model was determined by analysis of the substitution model of 7.0 MEGA program.

2. Development of learning media

The research method of developing audio-visual media analysis of fruit fly DNA was conducted according to Model Lee and Owens (2004) [7]. This model provides a strong conception, on practice based on proven theoretical principle principles, and is complemented by guidance frameworks. Thus the process of designing and developing audio-visual media is easy to learn and apply. The research consists of 5 stages: The development model consists of 5 stages: analysis, design, development, implementation and evaluation (Figure 1).

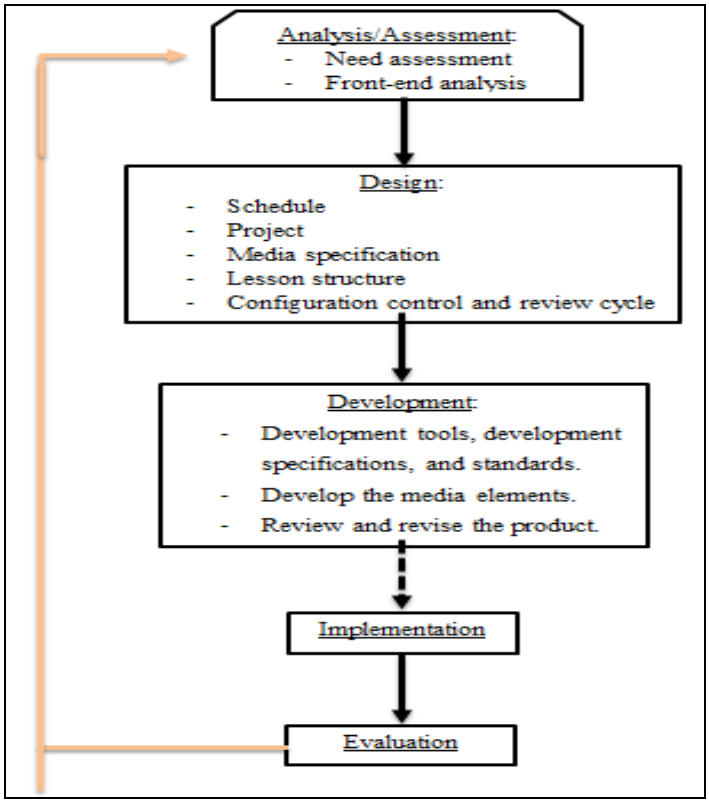

Fig 1: Development of audio visual model dna analysis of fruit fly isolate salaca sp for genetic concept learning

Data Analysis

The answer data from the shared questionnaire to get an overview of the applied medium is calculated using the formula:

$$\text{Presentation of Answers} = \frac{\text{Answers x value of answers}}{\text{N x highest value of answers}} \text{ x } 100\ \%$$

Explanation

$\sum$ = the frequency of the subject choosing an alternative answer

n = total number of questionnaire items

Furthermore, to calculate the percentage of all subjects in the student response test used the formula:

Persentation = F : N

Explanation
F = Total percentage of the subject
N = the number of objects
The quality of audio-visual media products, determined based on the conversion of achievement and qualification levels (Rosang, 2016) (Table 1).

Table 1: Convert levels of achievement and qualification

Achievement Level	Qualification	Explanation
90% - 100%	Very high	Very feasible, no need to be revised
75% - 89%	High	feasible, need not be revised
65% - 74%	moderate	less feasible, needs to be revised
55% - 64%	Less	not feasible, need to be revised
0% - 54%	Very less	very unfeasible, needs to be revised

The results of data analysis are used to revise product development. Developed audio visual media is considered successful and feasible if it reaches the minimum achievement level criteria of 75%.

Results and Discussion

Results

Content analysis of instructional media is done by material experts, learning media experts and design learning experts. The quality of the product based on the results of the material analysis by the expert is 84% (high qualification). Thus from the aspect of learning media material worthy of applied without requiring revision. Product quality based on expert media analysis result is 82.8% (high qualification). On the other hand, the results of the analysis of the study design expert stated that 85% (high qualification) of audio-visual media analysis of fruit fly DNA was valid. Characteristics of material analysis, media and design are shown in table 2, table 3 and table 4. Based on the result of the analysis, the analysis media of DNA of fruit fly can be field tested in learning of genetic material topic in SMA.

Tabel 2: Analisis Contents

No	Statements	Score
1	Conformity of the title to the content of the material in the audio-visual media DNA analysis shown.	4
2	Audio (sound) and visual (impressions) conformance with material content in the audio visual media of the DNA analysis shown.	5
3	Clarity of material content presented.	4
4	Truth content of the material presented.	4
5	Completeness of material content presented.	4
6	Conformity of material content with KI and KD.	4
7	Completeness of the order of presentation of the contents of the material.	4
8	Clarity of the order of presentation of the contents of the material.	4
9	Ease of presentation of material content for students to understand.	4
10	The tendency of students to want to learn again or repeat the content of the material packed in audio visual media DNA analysis.	5
	Jumlah	42

Table 3: Results of media expert analysis

No	Pernyataan	Score
1	Accuracy of selection of types of hardware (computers / laptops, projectors, and speakers) in the development of audio visual media DNA analysis.	5
2	The accuracy of choosing the type of software (Camtasia Studio 10.1.1 program) in the development of audio visual media DNA analysis.	4
3	The accuracy of the use of Lee and Owens' development model in the development of audio-visual media DNA analysis.	4
4	Suitability of KD, KI, and Learning Objectives with audio-visual media DNA analysis.	4
5	The clarity of visual display in the form of text, images, animation, and video in the audio visual media of DNA analysis.	4
6	Audio clarity in the form of narration, music, and sound effects (audio effects) in audio visual media DNA analysis.	4
7	The suitability of the composition of images, text, and colors in audio-visual media DNA analysis.	4
8	Level of convenience to access or open audio visual media DNA analysis.	5
9	Interest in the audio-visual media of DNA analysis in the study of Genetic Substance.	4
10	The appeal of the use of image layouts, text, and colors in audio-visual media DNA analysis.	4
11	Ideal duration in audio-visual media DNA analysis.	3
12	Use of cognitive tools (introduction and conclusion) in audio-visual media DNA analysis.	4
13	The ability of audio visual media DNA analysis in making students want to repeat the audio-visual media.	4
14	The audio-visual media capabilities of DNA analysis in motivating and enhancing students' curiosity.	5
	Amounts	58

Table 4: Results of learning design expert analysis

No	Pernyataan	Skor
1	The accuracy of the use of design / design based on the Scientific Approach in presenting the audio-visual media of DNA analysis.	4
2	Suitability of KD, KI, and Learning Objectives with audio-visual media DNA analysis.	4
3	Suitability of time duration with student characteristics.	4
4	The appropriateness of audio-visual media use of DNA analysis in preliminary learning activities (apperception).	4
5	Clarity and depth of material presented.	5
6	Ease material for students to understand.	4
7	The attractiveness of audio-visual media analysis of fruit fly DNA	4
8	The use of communicative language.	4
9	The audio-visual media capabilities of DNA analysis in enhancing students' curiosity.	4
10	The ability of the audio visual media of DNA analysis to inspire and motivate students to enter in learning.	4
11	The tendency of students to want to learn again or repeat the audio visual media DNA analysis	5
12	Ease of audio-visual media DNA analysis for use.	5
	Amounts	51

Student responses to audio visual learning media analysis of fruit fly DNA, in SMA Negeri 1 Ratahan obtained 88.6% of students stated, learning media interesting and easy to understand.

Discussion

1. Audio visual media quality based on expert content validation result

Based on expert assessment of content, obtained the number of scores 42 with 84% percentage. This shows the quality of audio visual media DNA analysis of fruit flies is in high qualification. Learning media analysis of fruit fly DNA based on expert analysis, not found misconcept or concept that is still difficult to be understood by high school students. The audio-visual media of fruit fly DNA analysis has been compiled based on the scope of DNA material review for High School Students. The concept of DNA as a genetic material is explained from the cellular level at the beginning. This enables students to comprehend DNA comprehensively. Be able to distinguish between chromosomes, DNA, RNA and Gen. There are many misconceptions about genetic material in high schools in North Sulawesi (Sumampouw *et al*., 2017, Mokosuli, 2014) [11, 11]. Misconception not only on students but also teachers of Wurarah and Mokosuli, 2016). Concept errors are also found in students majoring in biology of Manado State University who have not studied genetics courses and molecular biology (Sumampouw and Mokosuli, 2017) [11]. This indicates that the concept of genetic material is still not effective in learning in high school. It is necessary media learning that can explain the concept of DNA that is abstract to be concrete for learners.

Learning media is a solution to study DNA in high school even feasible applied to the first year students of Biology Teacher education program. Learning media has been able to provide space for learners to understand the flow of DNA analysis so that it has an understanding of how the DNA analysis laboratory work. In fact empirically in the School, learning the topic of DNA can not be done through laboratory experimental methods because of limited laboratory facilities. Through this audio visual media, learners can audio-visual follow the stage of DNA analysis conducted by experts in the laboratory. DNA analysis up to the sequencing stage can not be done in high school because of the limitations of tools, materials and costly. This understanding becomes very valuable for students to develop their thinking power especially in the field of biology. Some students after the pilot activities raised their interest to study the S-1 studies in biology. This indicates that the learning media being piloted has been able to stimulate the deep curiosity of the students. Learning DNA in high school during this time generally only in the form of images has caused quite confusion in students and not able to stimulate the curiosity of students.

2. Audio visual media quality based on results of media learning expert validation

The quality aspect of instructional media has been well received by students both in the aspect of clarity of information in the form of sentence, sound and video quality. Based on the expert assessment of learning media obtained the number of scores of 58 with a percentage of 82.8%. This shows the quality of audio visual media DNA analysis of fruit flies is in high qualification thus effectively and efficiently. Categorized high because of achievement in every aspect of pennification in questionnaire, which obtained score 5 on three aspect, that is accurate choice of hardware type (computer / laptop, projector, and speaker); level of accessibility to access or open audio visual media and audio visual media analysis capabilities in motivating and enhancing students' curiosity. Score 4 is mostly given on the aspect of accurate selection of software type (Camtasia Studio Program 8); accuracy of the use of the development model; conformity of basic competencies, core competencies and objectives Learning with audio-visual media DNA analysis; the clarity of the visual display (image text, animation and video); audio clarity (narration, music, and sound effect); suitability of drawings, texts, and colors; ability to stimulate students' learning interest; use of cognitive tools (introduction and conclusion); and audio visual media capabilities of DNA analysis in making students want to repeat the audio-visual media. In visual media research visaul percentage of 80% of the results of expert media analysis has been included very good category (Rosang, 2015) [10].

3. Audio visual media quality based on expert design learning validation results

Based on the assessment of design expert learning obtained the number of scores 58 (82.8%). This shows the quality of audio visual media DNA analysis of fruit flies is in high qualification. Skoring 5 is given to experts on the aspect of clarity and depth of material presented, the tendency of students to want to study again or repeat the audio visual media DNA analysis, and the ease of audio visual media DNA analysis to use. While scoring 4 is most often given on the aspect of appropriateness of the design / design based on the Scientific Approach in presenting the audio-visual media of DNA analysis, the suitability of basic competence, core competence, and learning objectives with audio-visual media

DNA analysis, conformity with student characteristics, the use of audio-visual media DNA analysis on the learning activities of the introduction (apersepsi), the ease of the material to be understood by the students, the ability of the audio visual media to stimulate students 'interest in learning, the use of communicative language, the ability of audio visual media in improving students' curiosity, visual in evocative and motivate students to enter in learning. Similar research conducted by Pratiwi (2013) [9], obtained a percentage assessment of design experts 75%.

4. Feasibility of audio visual media based on student response test results

The result of the student's response test to the audio-visual media analysis of the fruit fly DNA, showed 54% strongly agreed, 35% agreed and 11% students neutral. Overall 88.6% of students stated the audio-visual media DNA analysis of fruit flies can be understood and interestingly used as a medium of learning.

Conclusion

Based on the development research that has been done, it is concluded that the audio visual media analysis of mitochondrial DNA fruit flies declared feasible used in biology learning in high school.

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