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Development of Audio Visual Learning Mediaof Biology on the Concept of DNA, Based on the Results of Molecular Identification of Payangka Fish from Lake Tondano

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Abstract: Payangka fish [*Ophieleotrisaporos* (Bleeker)] is one of the endemic species in Lake Tondano, Minahasa Regency, North Sulawesi. Empirically, Payangka fish is widely known by the Minahasa community. Identification of fish molecule has not been reported. This research begins with the molecular identification of Payangka fish and is developed in the form of audio-visual media for learning genetic material in high school. The topic of molecular genetic studies has one of biology learning that is considered complicated in high school. The characteristics of DNA material were abstract and were a combination of biological, physical and chemical studies. Practical activities of DNA analysis using molecular identification methods in high schools are difficult because they require sophisticated tools. Nevertheless, the concept of DNA as a key material in molecular biology is becoming a standard in the international biology curriculum. This research provides a solution by developing a molecular identification practicum carried out at the Unima FMIPA Biology laboratory and packaged in audiovisual media. Another advantage is the object of molecular identification, namely Payangka fish is an endemic species of Lake Tondano. This type of research was development research proposed by Tiangarajan, the 4D model. As the name implies, there were 4 stages in this research, namely Define, Design, Development, and Disseminate. To test the validity of this learning media, a trial is carried out. The test subjects consisted of two material experts, two instructional media experts, one subject teacher, and ten students for field trials. Data on the feasibility of this learning media product was collected by rubric and team evaluation. The collected data will then be analyzed with qualitative descriptive techniques and descriptive statistics. The results of this study were to indicate the level of eligibility or product validity is in very good criteria with a percentage of 92.87%.

Keywords: *DNA analysis, development of audio visual media, Payangka.*

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Introduction

Biology learning is one of learning which prioritizes the process of scientific method. Observation is usually done by exploring the natural surroundings. Learning biology can be done by observing biodiversity of local flora and fauna, collecting specimens and doing practicum. However, learning activities are very dependent on the characteristics of the subject being taught. The use of audio visual learning media can be a solution for learning activities that cannot be done through direct observation or because of limited tools and materials (Ariyanto, Priyayi, & Dewi, 2011; Rosmah, Tindangen, & Rambitan, 2018). Today's learning media must be able to integrate information on computer technology and local biodiversity (Nugraini, Choo, Hin, & Hoon, 2013).

Biology has many branches of science, although genetics is the main foundation of all concepts in biology. Previous research has found that concepts in genetics are difficult to understand for students in Tomohon City (Mokosuli & Sumampouw, 2017; Pendong, Mokosuli, & dan Sumampouw, 2010). Likewise many teachers have difficulty in learning genetic material. The object of genetic studies ranging from genes, DNA, chromosomes and cells is abstract (Tumbel, 2017; Trianto, 2009). In contrast to the study of morphology, anatomy, ecology and environment the object of study can be directly observed using the five senses (Sumampouw, Semuel, & Oka, 2017).

Conducting experiments through specific practical activities in the field of gene and DNA studies is still difficult to do in high schools in Indonesia. In addition to requiring sophisticated laboratory equipment facilities, it also requires large

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costs and quite a long time. One alternative that can be done is to develop an audio visual learning media that demonstrates the analysis of genes and DNA integrated with genetic concepts.

As a megabiodiversity country, Indonesia has the third largest diversity of flora and fauna in the world. Furthermore, the island of Sulawesi has the largest endemic biodiversity in Indonesia (Mokosuli, 2013). One species of fish known by the Minahasa community is Payangka fish. Payangka fish are exotic fish found in Lake Tondano. Lake Tondano is one of the largest lakes on the island of Sulawesi. The naming of the Payangka fish species, Ophieleotris aporos (Bleeker) was only carried out in 1977 (Soeroto, 1988). Some experts claim that the fish are classified as primitive fish belonging to the family eleotridae. The young stadium of Payangka fish is known as Nike and is very well known by the Minahasa community. Payangka has become a species of fish with high economic value and is widely consumed in Minahasa. However, the molecular identification of Payang fish from Lake Tondano based on literacy research has never been reported. In this study mitochondrial DNA, namely the CO1 gene and the 16S RNA gene, was used to identify the fish with a molecular approach (Kochzius et al., 2010; Ward, Hanner, & Hebert, 2009). The 16 S RNA gene is used because this gene is older than the CO1 gene so that it can complete molecular identification data using the CO1 gene (Hubert et al., 2008; Pegg, Sinclair, Briskey, & Aspden, 2006). The phases of the analysis of the DNA of Payangka fish are then packaged and developed into audio visual learning media. In this present study, it is known how the teacher and student responses to the results of the development of audio visual learning media, based on the analysis of Payangka fish laboratory.

Methodology

Research methods

This research applies research and development methods. Research and development methods as a research method used to produce certain products. This research produces a product for use in learning that is audio visual based learning media in the form of video. The initial stage of the research was the identification of molecular fish using marker genes from mitochondrial DNA.

A. Molecular identification of Payangka Fish

The research phase was carried out through mitochondrial DNA analysis activities for Payangka fish. Payangka fish samples were obtained from Lake Tondano, Minahasa, North Sulawesi (Figure 1).

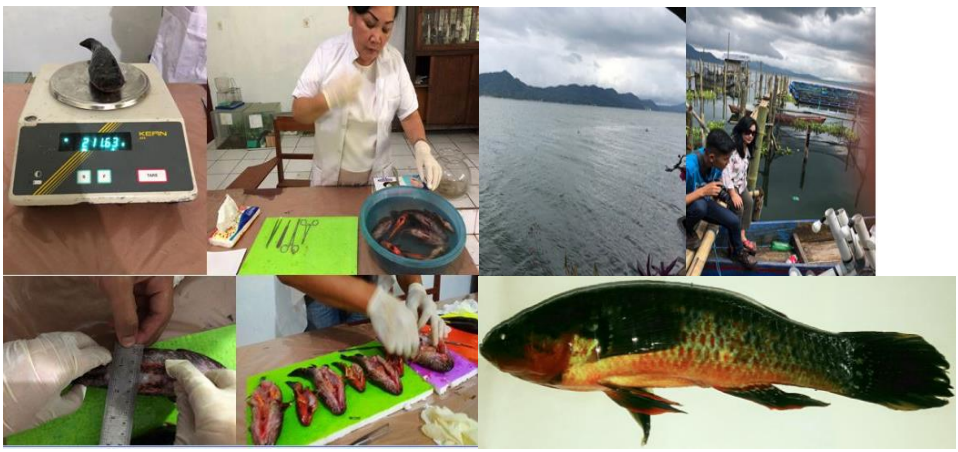


Figure 1. Preparation Payangka fish used for DNA analysis.

1. DNA Extraction and Purification

The extraction and purification of the mtDNA of the wild fish used the modified Quick-DNA ™ MiniprepPlus Kit procedure. The initial stage before entering the extraction of mtDNA is tissue dissociation which consists of taking 25 mg of abdominal muscle tissue and inserted in a tube then added Solid Tissue Buffer and 20 µl ProteinaseK incubated for 24 hours at 550C (Figure 2).

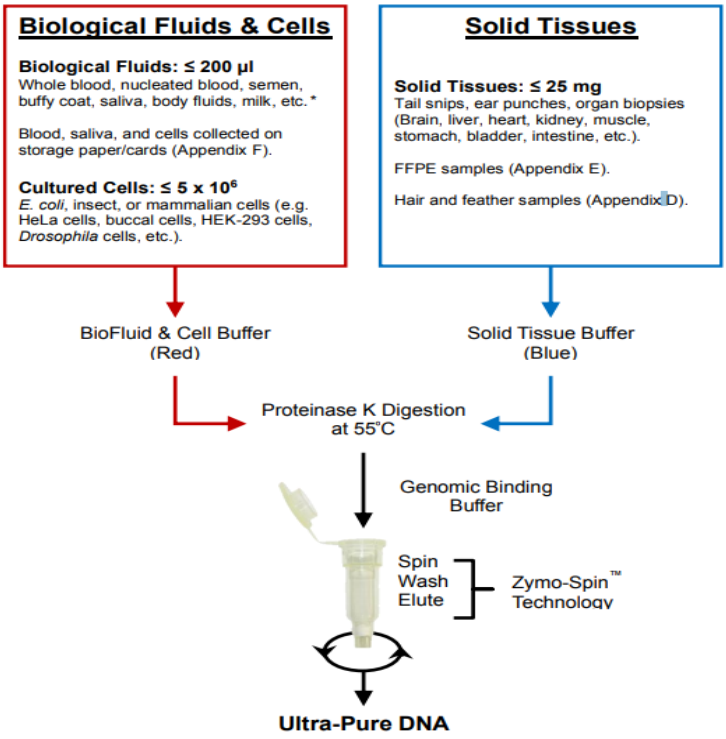


Figure 2. Procedure for DNA extraction and purification

2. Amplification of 16 S RNA genes by PCR method.

The PCR component used is 2x MyTaq HS Red Mix Bioline 25 µL, 16sA forward primer (5´CGC CTG TTT AAC AAA AAC AT 3´) 1 µL, reverse R16sB2 primer (5´TTT AAT CCA ACA TCG AGG 3´) 1 µL , DNA templete 2 µL, and ddH2O 21 µL. PCR conditions are initial denaturation of 72 ° C for 50 seconds then denaturation following 94 ° C for 30 seconds. Annealing 49 ° C for 40 seconds, extension 72 ° C for 50 seconds, final extension 72 ° C for 5 minutes.The number of cycles as much as 35 times. Amplicon visualization was carried out using agarose 0.9% electrophoresis method.

3. Sequencing and sequencing analysis

After being electrophoresed, sequencing was carried out to obtain the nucleotide base sequence of the 16 S RNA gene of the fish. This process is carried out at the First Base Laboratory, Singapore. Sequencing using ABI PRISM 3730xl Genetic Analyzer Developed by Applied Biosystems, USA. The sequencing results obtained were analyzed with Geneious 9.0 software (Kearse et al., 2012) and the Mega 6 Program (Tamura, Stecher, Peterson, Filipski, & Kumar, 2013). The sequences obtained were then carried out a homology analysis using the Basic Local Alignment Search Tool on the National Center of Biotechnology Information website (https://blast.ncbi.nlm.nih.gov/Blast.cgi). Reconstruct phylogeny trees using the neighbor-joining method. Calculation of genetic distance matrix with Kimura-2 parameter model implemented in pairwise distance calculation with Bootstrap 1000 replications in the MEGA (Molecular Evolutionary Genetics Analysis) software version 6.0 (Tamura et al., 2013). The sample sequences were compared with several NCBI Bank Gen collection.

B. Development Stage

The development phase adopts the development model proposed by Thiagarajan et al. This development model is known as 4D. This 4D development model has 4 stages namely Define, Design, Develop and Disseminate (Tritanto, 2011).

1. *Define*

Define phase consists of four main steps, namely: front end analysis, student analysis, task analysis, concept analysis, and formulation of learning objectives (Tritanto, 2011). At this define stage, the initial step taken is the front end analysis by analyzing the basic problems and demands of the future (Rina & Suci, 2012). The step to determine the potential problem is the researcher makes observations to determine the condition of the teacher and students, learning methods, media and learning resources used. In this stage observations were also made to support the selection of appropriate media and appropriate levels of student learning. Next is analyzing student characteristics, analyzing concepts, analyzing assignments, and formulating goals (Tiangarajan, 1974).

2. *Design*

In the design phase, researchers conducted pre-production by designing audio visual based learning media in the form of learning videos. Learning videos created using Microsoft Office PowerPoint 2013 and Camtasia studio 8 applications as editing tools, which contain material about DNA taught in high school that includes chromosome, DNA and gene relationships, DNA structure and DNA replication, and coupled with stages for DNA analysis mitochondria from Payangka fish.

3. *Develop*

The develop phase is carried out after passing the step of making audio visual based learning media design in the form of learning videos. Furthermore, existing media designs were tested on trial subjects consisting of material experts, instructional media experts, subject teachers and students included in small groups. The trial subject will be given a rubric as an instrument of assessment of the media that has been made. From the results of the assessment it will be seen the effectiveness of the media, after which a revision will be made to improve the quality of the learning media. In the develop phase, it is also at the same time with the media evaluation stage that has been made.

4. *Disseminate*

The disseminate phase is carried out in small groups consisting of 10 students each from three state high schools in Minahasa. Disseminate which is an attempt to introduce products that have been produced more widely.

C. Product trials

1. *Trial design*

The trial design of the development of audio-visual media-based learning media in the discussion of genetic material in this study can be seen in Figure 3.

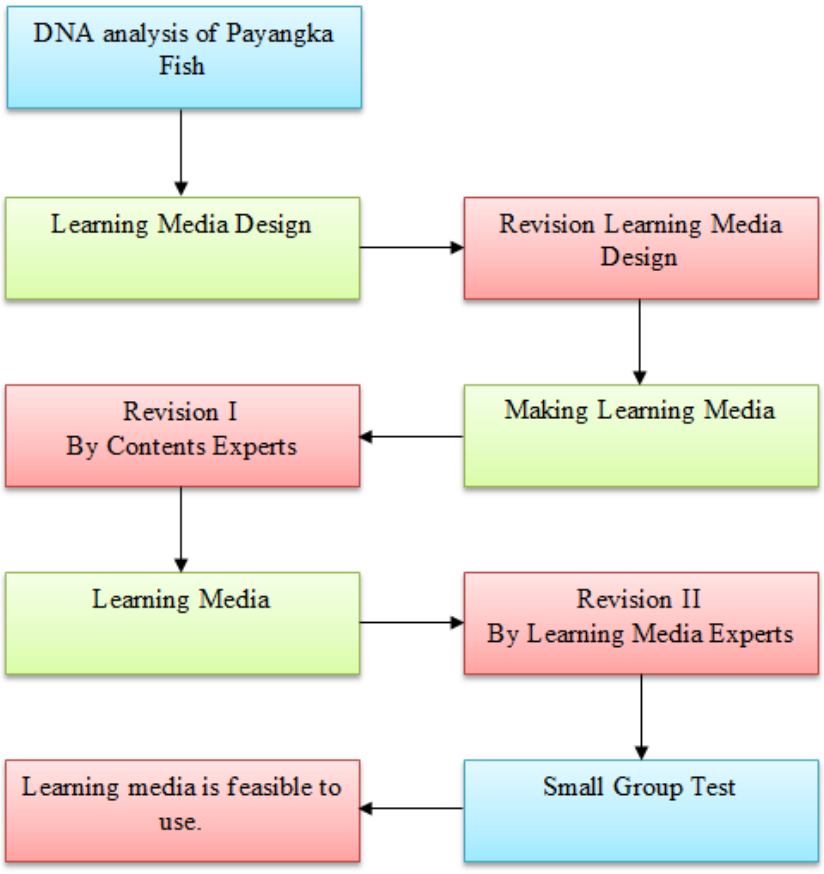


Figure4. Product trial flow chart.

2. *2. Subject of the trial*

1) Expert contents or biological material

The determination of content experts or material is based on several considerations, namely having a background in genetics and mastering material related to molecular genetics.

2) Learning Media Expert

The determination of instructional media experts is based on several considerations, namely having an educational background in learning media technology, and having expertise in designing instructional media.

3) Subject Teachers

The teacher who was the subject of the trial was a biology teacher at Langowan State High School, Remboken State High School, State High School 1 Tondano.

4) Small Group Test

The small group test consisted of 10 students from class XII Natural Sciences in three state high schools in Minahasa.

Data type

The type of data in this study is in the form of qualitative data and quantitative data. Qualitative data were obtained from content or material expert responses, instructional media experts, subject teachers, and students in high schools included in small groups and with the results of interviews. While quantitative data obtained from the rubric assessment results distributed to content experts, instructional media experts, subject teachers, and students in state high schools in Minahasa which are included in small groups.

Data collection instruments.

Data collection instruments in this study were by:

1. Interview

Moleong (2009) argues that interviews are conversations conducted by two parties, namely the interviewer who raises the question and the interviewer who gives the answer to that question. Based on the above understanding data collection by interviewing content experts, learning media experts, subject teachers, and students in small groups.

2. Questionnaire

Questionnaire is a data collection technique that is done by giving a set of questions or statements in writing to respondents to be answered (Suiyono, 2013). The use of questionnaires in this study was used to collect quantitative data from the learning media developed. The questionnaire was given to test subjects consisting of content experts, instructional media experts, subject teachers, and students in small groups. Validity analysis uses Product Moment Correlation while reliability analysis uses Cronbach's Alpha. Analyzes were performed using IBM SPSS 20 software.

Data analysis technique

This research development uses two data analysis techniques, namely qualitative descriptive analysis and descriptive statistical analysis.

1. Qualitative Descriptive Analysis

This qualitative descriptive analysis is used to process data from the results of interviews on the test subjects. This analysis technique is used by grouping data information in the form of responses, criticisms or suggestions for improvement. This data analysis is used as a reference to improve or revise audio visual based learning media development products.

2. Descriptive Statistics Analysis

Descriptive statistical analysis is used to process data collected from questionnaires. The results of this questionnaire will be analyzed to get a picture of the quantitative value of the media to be developed. The formula (Sugiyono, 2015) that researchers use in analyzing the results of this questionnaire is as follows:

$$P\ (S) = \frac{S}{n} \times 100\%$$

Description:

P (S) = percentage overall

S = overall weight obtained from each expert's questionnaire = score calculated

N = highest weight of the whole questionnaire = criterion score

The results obtained from the calculation of the questionnaire assessment using the formula above, will then be matched with the eligibility or validity criteria. From this matching it will be known whether the learning media that researchers have developed is appropriate for use or not. The eligibility criteria can be seen in the following table:

Table 1. Eligibility level criteria

Level of achievement (%)	Qualification	Description
90-100	Very high	Very decent, no need to revise.
75-89	High	Decent, no need to revise
65-74	High enough	Inadequate, needs to be revised
55-64	Not high enough	Not feasible, needs to be revised
0-54	Very not high enough	Very improper, needs to be revised

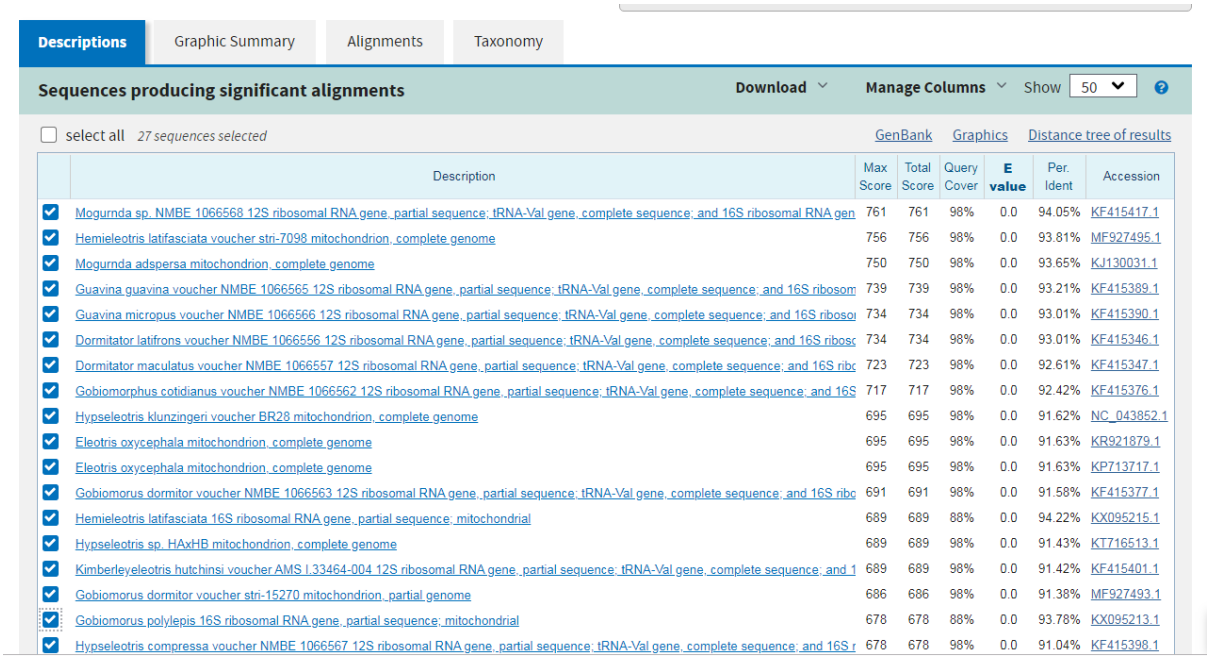
Findings / Results

DNA analysis

The consensus sequences of 16 S RNA genes were analyzed by the Geneous program in the Geneous length 558 bp. GC percentage is 48.8%. Based on the 16S RNA gene sequencing chromatogram band, the sequenced fish performed well (Figure 5).

Figure 5. Sequence of 16 S RNA of Payangka Fish

The results of the alignment analysis by the BLAST method at the NCBI site, the sequence of 16 S RNA gene sequences from Lake Tondano has the closest similarity to Mogurnda sp [KF415417.1] reported by Agoretta et al. (2013) in the United Kingdom. The level of similarity of sequences of 16 S RNA in the payangka and Mogurnda sp [KF415417.1] was 94.05% (Figure 6).



Descriptions | Graphic Summary | Alignments | Taxonomy

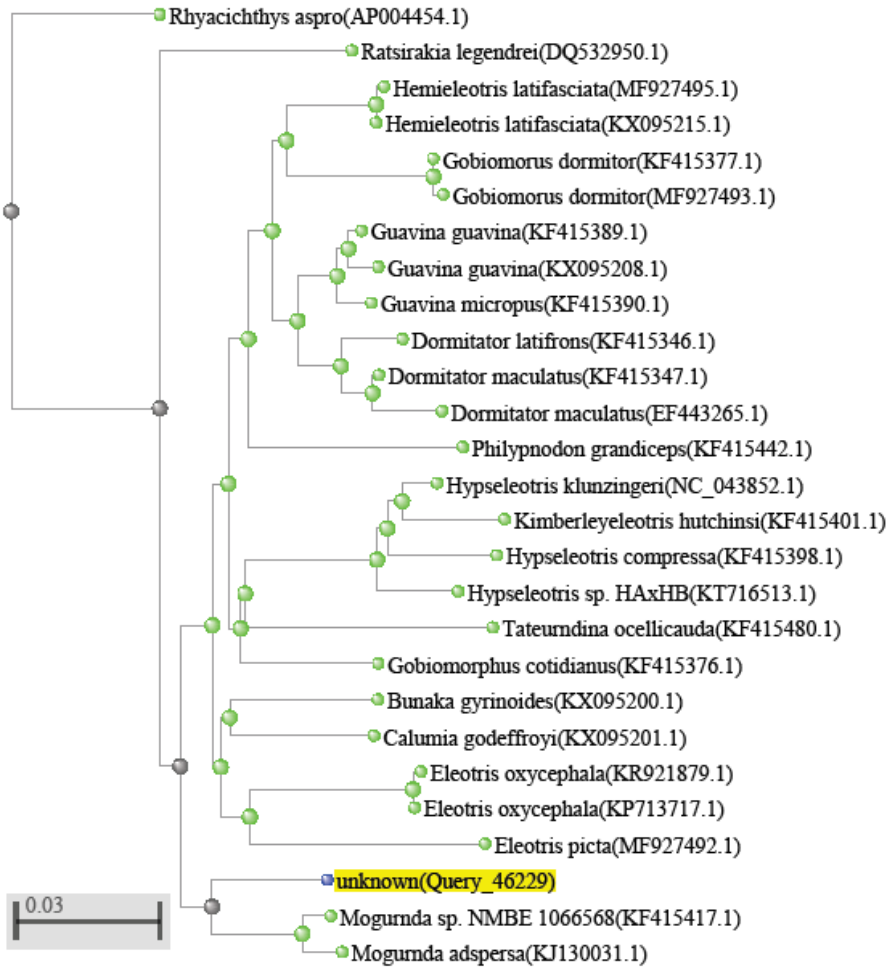
Sequences producing significant alignments — Download — Manage Columns — Show 50

select all 27 sequences selected — GenBank | Graphics | Distance tree of results

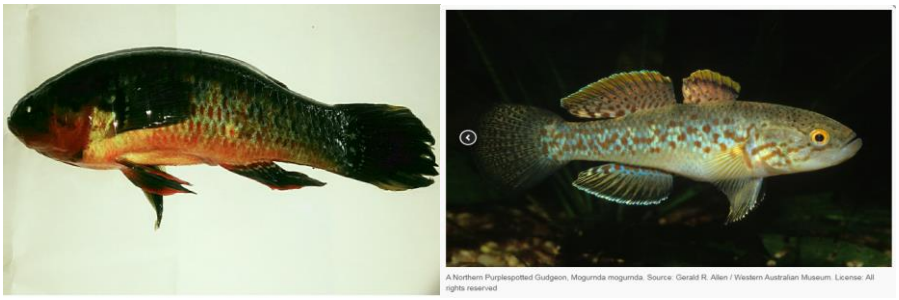
Description	Max Score	Total Score	Query Cover	E value	Per. Ident	Accession
Mogurnda sp. NMBE 1066568 12S ribosomal RNA gene, partial sequence; tRNA-Val gene, complete sequence; and 16S ribosomal RNA gen	761	761	98%	0.0	94.05%	KF415417.1
Hemieleotris latifasciata voucher stri-7098 mitochondrion, complete genome	756	756	98%	0.0	93.81%	MF927495.1
Mogurnda adspersa mitochondrion, complete genome	750	750	98%	0.0	93.65%	KJ130031.1
Guavina guavina voucher NMBE 1066565 12S ribosomal RNA gene, partial sequence; tRNA-Val gene, complete sequence; and 16S ribosom	739	739	98%	0.0	93.21%	KF415389.1
Guavina micropus voucher NMBE 1066566 12S ribosomal RNA gene, partial sequence; tRNA-Val gene, complete sequence; and 16S ribosou	734	734	98%	0.0	93.01%	KF415390.1
Dormitator latifrons voucher NMBE 1066556 12S ribosomal RNA gene, partial sequence; tRNA-Val gene, complete sequence; and 16S ribosc	734	734	98%	0.0	93.01%	KF415346.1
Dormitator maculatus voucher NMBE 1066557 12S ribosomal RNA gene, partial sequence; tRNA-Val gene, complete sequence; and 16S ribc	723	723	98%	0.0	92.61%	KF415347.1
Gobiomorphus cotidianus voucher NMBE 1066562 12S ribosomal RNA gene, partial sequence; tRNA-Val gene, complete sequence; and 16S	717	717	98%	0.0	92.42%	KF415376.1
Hypseleotris klunzingeri voucher BR28 mitochondrion, complete genome	695	695	98%	0.0	91.62%	NC_043852.1
Eleotris oxycephala mitochondrion, complete genome	695	695	98%	0.0	91.63%	KR921879.1
Eleotris oxycephala mitochondrion, complete genome	695	695	98%	0.0	91.63%	KP713717.1
Gobiomorus dormitor voucher NMBE 1066563 12S ribosomal RNA gene, partial sequence; tRNA-Val gene, complete sequence; and 16S ribc	691	691	98%	0.0	91.58%	KF415377.1
Hemieleotris latifasciata 16S ribosomal RNA gene, partial sequence; mitochondrial	689	689	88%	0.0	94.22%	KX095215.1
Hypseleotris sp. HAxHB mitochondrion, complete genome	689	689	98%	0.0	91.43%	KT716513.1
Kimberleyeleotris hutchinsi voucher AMS I.33464-004 12S ribosomal RNA gene, partial sequence; tRNA-Val gene, complete sequence; and 1	689	689	98%	0.0	91.42%	KF415401.1
Gobiomorus dormitor voucher stri-15270 mitochondrion, partial genome	686	686	98%	0.0	91.38%	MF927493.1
Gobiomorus polylepis 16S ribosomal RNA gene, partial sequence; mitochondrial	678	678	88%	0.0	93.78%	KX095213.1
Hypseleotris compressa voucher NMBE 1066567 12S ribosomal RNA gene, partial sequence; tRNA-Val gene, complete sequence; and 16S r	678	678	98%	0.0	91.04%	KF415398.1

Figure 6. Similarity sequnece

The phylogeny tree construction at the NCBI site using the Neighbor Joining model with 26 similar sequences from the BLAST results placed the Tangka payangka fish from Lake Tondano in a monophyletic group with *Mogurnda* sp [KF415417.1] and *Mogurnda adsversa* [KJ130031.1]. However, Payangka fish from Lake Tondano is not in one node with *Mogurnda* sp. This indicates that based on the 16S RNA gene, fish from Lake Tondano have many differences from Mogurnda or are in other species. The morphology of the Payangka fish is different from that of Mogurnda (figure 7).



(a)



(b) (c)

Figure 7 *(a) Phylogenic tree of payangka fish (the unknown) and 26 sequences of BLAST results on the NCBI website*

(b) Payangka fish from Lake Tondano

(c) Mogurnda sp

Development of Learning Media

After making the contents of the material from this audio visual learning media, the development stage is continued with the 4D development model, which consists of the following steps: 1) Define; 2) Design; 3) Development; and 4) Disseminate. This development model has complete stages, namely to the disseminate stage so that later learning media can be used en masse. Define phase consists of several stages, all of which aim to gather information that underlies the need for the development of audio-visual learning media at the State High School in Minahasa. Some stages in the define steps were:

1) Front-End Analysis

Front end analysis is done by observation and interview. Observations were carried out in class XII Natural Sciences in several high schools in Minahasa. Observation results show that the learning process carried out is only in the form of lectures that are monotonous and record the material in the printed book. Next the developer interviewed the subject teacher, he explained that such a teaching process was due to the difficulty in concreting material about genetic material or other material related to genetics. He also explained that usually there is also a learning medium used which is the power point displayed through the LCD projector but students are less active in the learning process. The learning process in high school especially about genetic material is still conventional. So that these problems underlie the making and development of audio visual learning media in genetic learning in this high school.

2) Learner Analysis

Student analysis is a study of the characteristics of students in accordance with the development of learning tools (Thiangarajan, Semmel, & Semmel, 1974). Characteristics of students in high school from learning styles found that students tend to include visual learners, i.e. students more easily understand the material if they see examples or information or lessons. Learning styles that are also found are auditory learners, i.e. students like to interact by discussing and communicating with others. In addition to learning styles, students in high school have special skills in the field of technology, where they can and are accustomed to operating computers or mobile phones or other devices to access various information related to learning.

3) Concepts analysis

Based on the analysis of the concepts that have been carried out, the DNA material concepts learned are as follows:

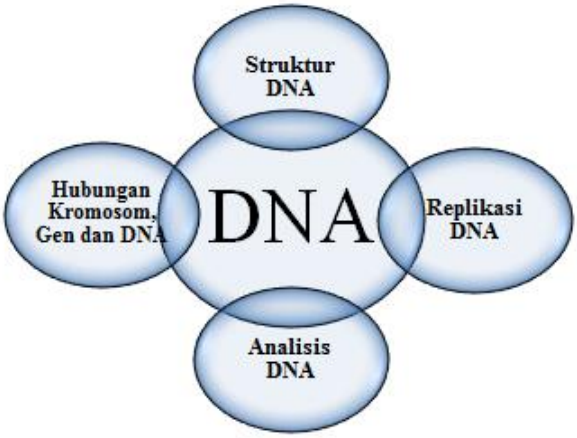


Figure8. Concenps of DNA

4) Task Analysis

Based on the results of the analysis of the tasks performed at the State High School in Minahasa in learning related to genetics, namely with the material details: chromosome relationships, genes and DNA, DNA structure, DNA replication, and DNA analysis, the tasks that students must do are formulated as in table 2:

Table 2. Results of Task Analysis

No.	Aspects	Tasks
1.	Knowledge	(a) Understanding the relationship of chromosomes, genes and DNA (b) Describe the structure and process of DNA replication (c) Sequencing DNA analysis steps
2.	Social Skills	(a) Asking question (b) Raise an opinion or idea about a problem (c) Discuss opinions or ideas that have been submitted with students or other study groups
3.	Attitude	(a) Feel happy when learning by using learning media (b) Feel happy in participating in learning biology in DNA material

The above tasks are applied during the process of learning DNA material using audio visual media in the form of learning videos with a scientific approach.

Formulation of Purpose

The objectives are formulated from the analysis of concepts and tasks based on competency standards and basic competencies and learning materials, the learning objectives are as follows:

a. Students can describe the relationship of cells, chromosomes, genes and DNA

b. Students can describe the structure of DNA

c. Students can describe the process of DNA replication

d. Students can sort the stages of DNA analysis

Stage 2.Design. In accordance with the meaning of this design stage is a stage for creating content designs in audio visual learning media and making display designs. The flow of learning media in the form of this video consists of the opening part, the core material and the closing. The three parts consist of sections, which can be seen in the following chart:

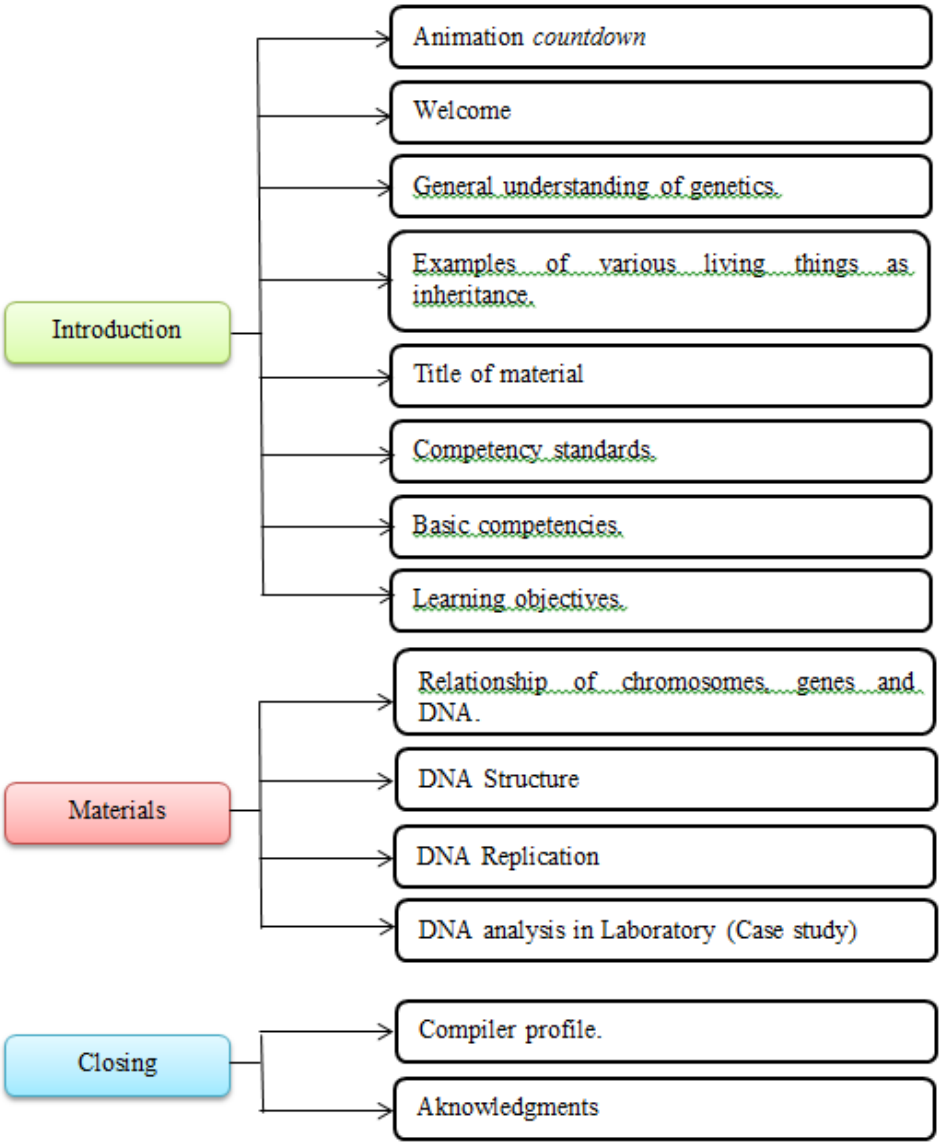


Figure 9. Learning media design chart

Stage 3. Development. At this stage the product is developed with a feasibility / validation test, revision, and a small group trial. It is intended to produce learning media products according to needs. The feasibility and validation tests in this stage involved content experts, instructional media experts, subject teachers, and tested on a small group of 10 students from class XII Natural Sciences in the Public High Schools in Minahasa.

Stage 4. Disseminate. This disseminate stage is carried out in a number of ways, which are distributed directly to students in small groups, and the learning video is uploaded to youtube.com so that it can be accessed easily, and produced through a DVD disc.

Study of audio visual learning media products

The product of the development of this learning media is audio visual media in the form of instructional videos. This video can be used practically, because it can be stored in the gadgets of students, so they can study anywhere and anytime. This learning video was created using a combination of functions from the Microsoft Office Power Point 2013 application and Camtasia Studio 8. The MS Office Power Point application is used to display theories related to DNA material. In general, if we hear the word "theory" that arise only a boring reading text. However, the sophistication of this application makes the theories displayed become more interesting because of the various choices of transitions (slide displacements) and animations that can be arranged in accordance with the wishes of the wearer. Its use is very easy, only coupled with a little creativity will create an interesting presentation. Here are some displays of the results of using the MS Office Power Point application (Figure 10).

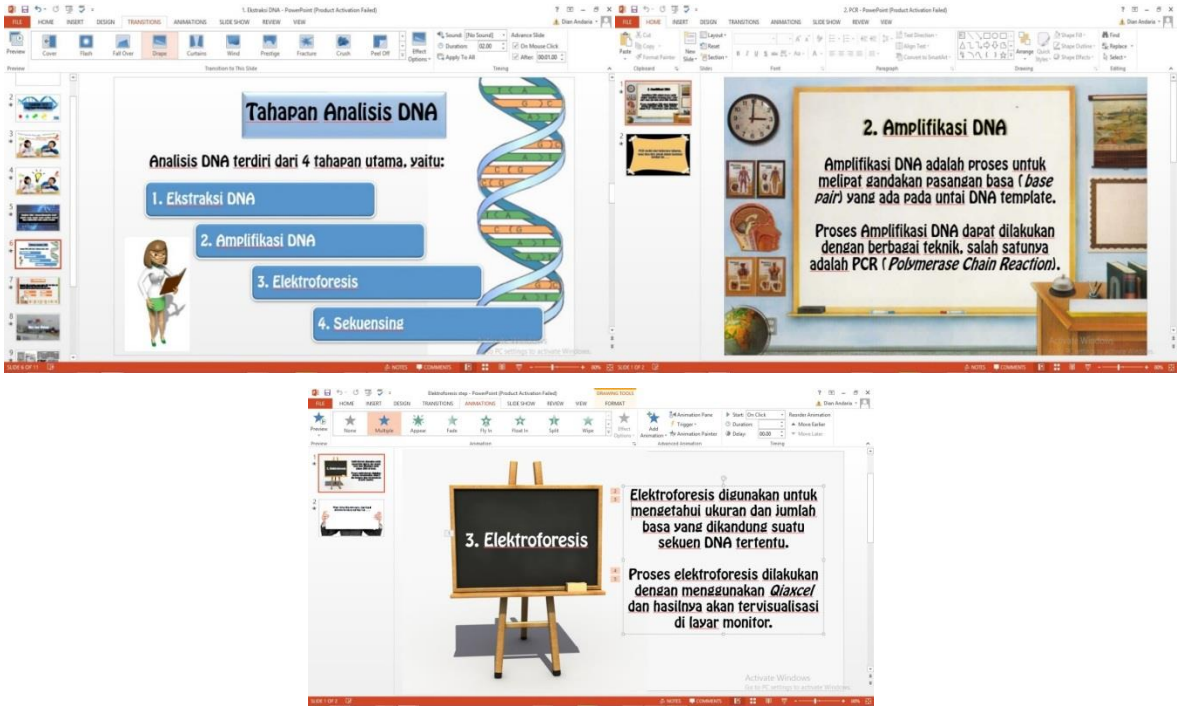


Figure 10. Display material presentation stages of the analysis of Payangka fish DNA.

The Camtasia Studio 8 application is used to edit videos, add background music and record narrative sounds. The end result of using the Camtasia Studio 8 application is a learning video developed. The appearance of the process of making learning videos with the Camtasia Studio 8 application can be seen in the appendix. The resulting learning video can be used with various media players such as VLC, Windows media player, GOM player, video player and other media players, which are on a computer, laptop, tab or cellphone, so that the teacher is easy to operate in learning and students can make videos learning as a practical learning resource (Figure 11). Besides this learning video is also produced into a CD cassette. This video has a duration of 25 minutes 40 seconds, with sections as follows:

a. Introduction

This section consists of countdown animations, greetings, general understanding of genetics, examples of various groups of living things as inheritance, title content or learning material, and competency standards (SK), basic competencies (KD), and learning objectives that are will be achieved.

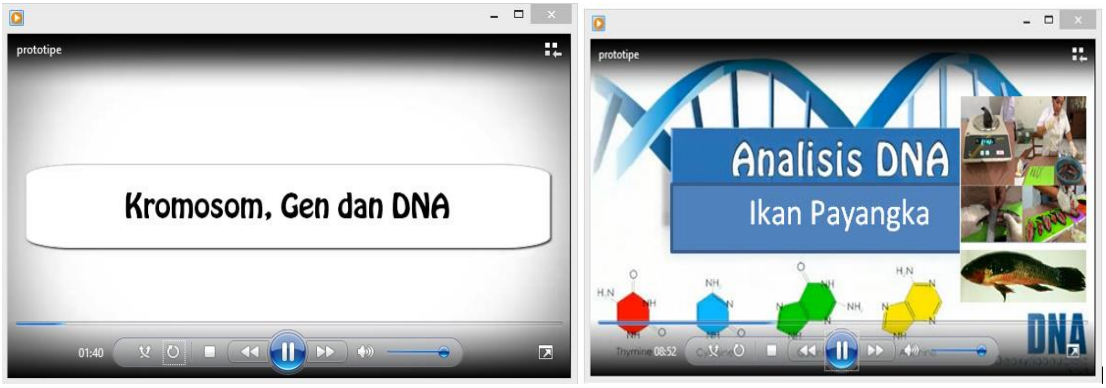


Figure 11. Audio visual learning media

b. Material Core

The core part of the material contains a series of materials in accordance with the learning objectives that have been formulated. This section presents material on the relationship of chromosomes, genes and DNA, DNA structure, DNA replication, and DNA analysis.

c. Closing

The concluding section contains the compiler profile, and an expression of thanks to those who have participated in making this genetic learning media.

Analysis of product assessment results data.

This study involved 4 assessor subjects, namely: content expert, instructional media expert, subject teacher, and small group test consisting of 30 students of class XII IPA namely Langowan State High School, Tondano State High School and Remboken State High School. Assessment of the product is intended to get the feasibility / validity of the learning media developed. The assessment process is carried out by filling in an assessment instrument in the form of a questionnaire that has been prepared by the developer.

From the calculation of the percentage of assessment results from the content / material experts above, viewed from the aspects of learning, material, and benefits, then obtained a percentage of 88%. Furthermore, the results of this percentage are matched with the eligibility level criteria in table 3.2 and the results of audio visual learning media in the form of instructional videos are included in the "high" qualifications with the information "decent, no need to be revised". The results of the assessment of the learning media experts above, showed a score of 85%. Furthermore, the results of this percentage are matched with the eligibility level criteria in table 3.2 and the results of audio visual learning media in the form of instructional videos are included in the "high" qualifications with the information "decent, no need to be revised". From the calculation of the percentage of assessment results for subject teachers, a percentage of 88.67% was obtained. Furthermore, the results of this percentage are matched with the eligibility level criteria in table 3.2 and the results of audio visual learning media in the form of instructional videos are included in the "high" qualifications with the information "decent, no need to be revised". Based on the calculation results of the percentage assessment of the small group above, a score of 86.2% was obtained. Furthermore, the results of this percentage are matched with the eligibility level criteria in table 3.2 and the results of audio visual learning media in the form of instructional videos are included in the "high" qualifications with the information "decent, no need to be revised".

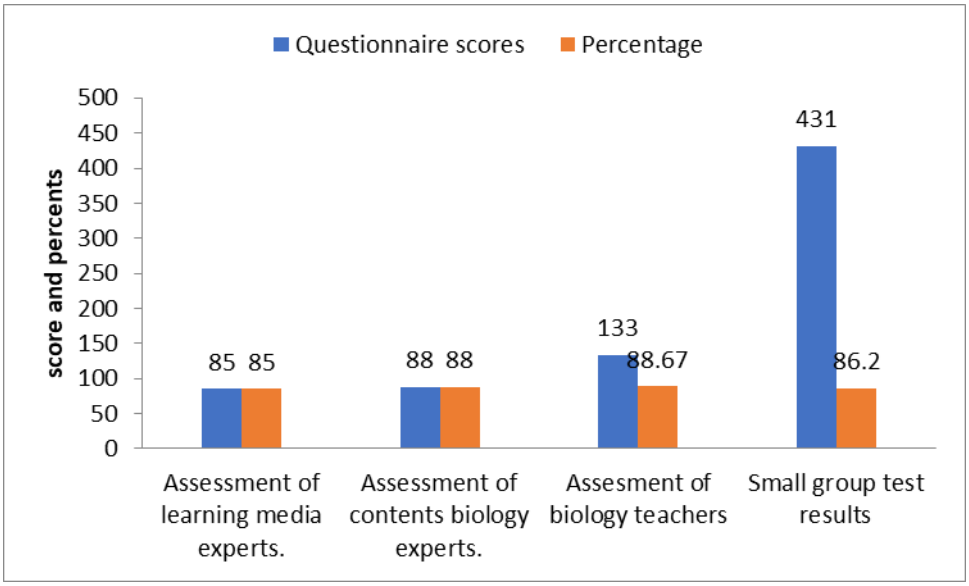


Figure 12. Assessment of material experts, media experts, teachers and small media learning test groups.

Discussion and Conclusion

Based on the analysis of DNA from Payak fish using the 16 S RNA gene, Payangka fish from Lake Tondano has the closest phylogeny relationship with *Mogurnda s*p [KF415417.1]. Phases of the analysis of the DNA of Payangka fish are packaged in the form of learning videos so that they can be said to be virtual laboratories. The material in the learning media that was developed consisted of DNA material based on the syllabus at the 2013 Curriculum High School. The learning media ended with a virtual laboratory, namely analysis of the DNA of payangka fish. DNA material in this learning media is adopted from various learning sources which are summarized in such a way that it becomes a material with an appropriate and easy to understand language. Furthermore, the addition of the DNA analysis process to the media content is carried out by practicing the process directly at the UNIMA Biomolecular and Biomolecular Laboratory. The DNA analysis process includes 4 main stages, namely DNA extraction and purification, DNA amplification, electrophoresis and sequencing (Revelson et al., 2019, Suddin, Mokosuli, Marcelina, Orbanus, & Ardi, 2019). The 16S rRNA and CO1 genes have been proven to identify giant freshwater prawn Macrobrachium rosenbergii populations in East Africa (Kuguru, Groeneveld, Singh, & Mchomvu, 2019). Furthermore, Zhao et al. (2019) also used cytochrome B, 12S rRNA, ND2, ND4, and ND5 genes in Sooty grunters and other major freshwater fishes in the Percoidei suborder with consistent results (Zhao et al., 2019).

The use of audio-visual media in learning biology, for difficult concepts such as DNA, greatly helps improve student understanding (Astuti & Nurcahyo, 2019; Howell et al., 2019; Sumampouw et al., 2017). The addition of DNA analysis experiments as content on learning media aims to concretize the concept of DNA which is usually studied in schools. These concepts include DNA structure material, in general students are familiar with the structure of DNA through double helix animation but with the DNA extraction analysis process students can see the shape of DNA directly. The shape of DNA that is seen directly with the eye is in the form of clear liquid, this liquid which later when viewed with an instrument will see the double helix structure. In addition to the concept of DNA structure, another concept that can also be concreted through DNA analysis is the concept of DNA semiconservative replication. This concept is applied through the process of amplification or multiplication of DNA strands by using the PCR method whose results are seen in the electrophoresis process.

Define phase is the stage of defining and determining learning requirements. Based on observations and interviews with students and teachers in several high schools in Minahasa, it is known that the learning process takes place conventionally because the material is abstract, the learning media is also not utilized by the teacher, it is very unfortunate because the school has adequate facilities to support learning Media. Supporting learning media facilities available are LCD projectors, as well as free wifi services intended for school communities.

The design phase contains the flow of learning media that will be developed, which is divided into 3 main sections namely opening, core material, and closing. The Development Phase is carried out due diligence / validity on media products that have been developed. This validity test is conducted by content experts, instructional media experts, subject teachers, and small group tests with a questionnaire as an assessment instrument. Based on the results of each trial subject, the validity test results obtained from content experts are 88%, instructional media experts are 85%,

subject teachers are 88.67%, and small group test results are 86.2% . From the above data it is known that audio visual media products in the form of instructional videos have high eligibility / validity qualifications with proper information do not need to be revised. So, audio visual learning media is feasible to be used in learning. The Disseminate phase is carried out by distributing videos directly to students through small group test activities, youtube, and produced through DVDs. Dissemination through small group test activities is done when the developer conducts research in schools. Distribution via YouTube is done so that students can access the media anywhere. Although this learning media product is developed as well as possible, it still has limitations, including the media cannot be used if the user does not have electronic devices such as computers or mobile phones, and also the media has a duration that is too long.

Based on the results of the study it can be concluded that the fish from Tondano based on the 16S RNA gene have the closest kinship with Mogurnda sp [KF415417.1]. The learning media developed are classified as very good; in the material aspects, learning design, teacher assessment and small group trials.' Based on the results of this study, the development of biology learning media using endemic animals and plants as objects of study can increase students' interest and motivation to learn. Curiosity is triggered because students already know animals and plants as objects of study studying biological concepts.

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Appendix 1. Quantitative Data Experts Assessment Content and Materials

Each question is given a choice of scores 1 - 5. The following is a summary of answers based on the average score.

No.	Criteria	Score
1.	Clarity of learning objectives	5
2.	The suitability of the material with the learning objectives	5
3.	The conformity of learning objectives with the media	5
4.	Suitability of the media with the characteristics of students	4
5.	Suitability of media with material characteristics	4
6.	The suitability of the title of the material with the material presented	5
7.	Ease of understanding material in the media	4
8.	Clarity of material description	5
9.	Material depth	4
10.	The appearance of material rashes	5
11.	Ease of understanding media illustrations	4
12.	Program support capacity for learning	4
13.	Media can be used at any time	5
14.	The accuracy of the sample image given to clarify the material	5
15.	The suitability of the material with the development of ICT	3
16.	Accuracy in spelling and term writing	4
17.	The use of language in the presentation of material	4
18.	Conversational language suitability	4
19.	Learning media attract the attention of students	4
20.	Learning media facilitate the delivery of material	5
	TOTAL	**88**

Quantitative Data Assessment Results of Learning Media Experts

No.	Criteria	Score
1.	Ease of operation of learning media	5
2.	Image quality is appropriate	4
3.	Video quality is appropriate	4
4.	Screen display quality	4
5.	Media display color composition	4
6.	The consistency of the layout (layout) of media display	4
7.	Appropriate font selection	5
8.	Appropriate font size selection	5
9.	Readability of the text	5
10.	Suitability of text color to background	4
11.	Suitability of language use for media objects	4
12.	There is no double interpretation of the language used	4
13.	Clarity in pronunciation of foreign languages	5
14.	The accuracy of the intonation of the conversation	4
15.	Sound intonation volume match	3
16.	Accurate use of music / backsound media	5
17.	Video sound clarity	4
18.	Media display attracts students' attention	4
19.	Learning media can be used at any time	4
20.	The length of the video is suitable for learning	4
	TOTAL	**85**

Quantitative Data on Subject Teacher Assessment Results

No.	Criteria	Score
1.	Clarity of learning objectives	5
2.	The suitability of the material with the learning objectives	5
3.	Suitability of the media with the characteristics of students	5
4.	Suitability of media with material characteristics	5
5.	Ease of understanding material in the media	4
6.	Clarity of material description	4
7.	Material depth	5
8.	The appearance of material rashes	5
9.	Ease of understanding media illustrations	5
10.	Media can be used at any time	3
11.	The accuracy of the sample image given to clarify the material	5
12.	Accuracy in spelling and term writing	5
13.	The use of language in the presentation of material	4
14.	Conversational language suitability	4
15.	Learning media facilitate the delivery of material	5
16.	Ease of operation of learning media	5
17.	Image quality is appropriate	4
18.	Video quality is appropriate	4
19.	Screen display quality	4
20.	Accuracy in selecting font types and sizes	5
21.	Readability of the text	5
22.	Suitability of text color to background	4
23.	Suitability of language use for media objects	5
24.	There is no double interpretation of the language used	5
25.	Clarity in pronunciation of foreign languages	5
26.	Ketepatan intonasi percakapan	4
27.	Accurate use of music / backsound media	4
28.	Video sound clarity	3
29.	Media display attracts students' attention	4
30.	The length of the video is suitable for learning	3
	TOTAL	**133**

Small Group Test Results 1.

No	Name of student	Score
1	Achmad Suryadi Mustir	41
2	Conny Christine Lametige	45
3	Deddi R. Makasaehe	46
4	Gesi Mansiri	43
5	Julianto M. Manansang	43
6	Juranli Pangisian	42
7	Kiflyanus Karji	36
8	Rahayu Umar	44
9	Sarah V. Betah	46
10	Stelly D.	45
	TOTAL	**431**