

# Development of Virtual Media Nata De Pina Based on Articulate Storyline to Improve Science Process Skills (SPS) of Grade IX Students in Biotechnology Material

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**Abstract:** This study aims to evaluate the feasibility, practicality and impact of the implementation of interactive learning media based on Articulate Storyline in the Conventional Biotechnology sub-material on the science process skills (SPS) of grade IX junior high school students. The research model used is the development of ADDIE with a quasi-experimental approach, pretest-posttest control group design. The subjects of the study consisted of 71 students divided into two classes; experimental class and control class. The results of data analysis showed that there was a significant increase in science process skills (SPS) using Articulate storyline-based media compared to the control class. The developed Articulate storyline-based media was feasible and practical to apply with an average score of 88.79 based on the assessment of material experts and media experts. The students' response to the media reached an average of 90.49 with a very good category. In the experimental class, it showed an increase in science process skills (SPS) with an N-gain value of 0.61 which was categorized as a moderate increase, with an average pretest value of 42.50 increasing to 77.08 in the posttest. These findings indicate that interactive learning media based on Articulate Storyline is effective in improving students' science process skills (SPS) and is recommended for application to other science materials.

**Keywords:** ADDIE; Articulate storyline; Biotechnology; Interactive learning media; Science process skills (SPS); Virtual media nata de pina

## Introduction

The development of information and communication technology has had a significant impact on various aspects of life including education. Current technological advances motivate teachers and education practitioners to develop interactive learning media that increase students' participation and science process skills. Al-Rahmi et al. (2015) stated that the use of appropriate learning media can improve the quality of student learning through active contributions and adjustments to the individual character of students.

Technology plays a role in teaching and learning activities, especially in the context of science learning which requires an understanding of complex and abstract concepts (Fasna et al., 2024; Rahmawati et al., 2023; Yilmaz, 2023).

One of the effective learning media development applications is Articulate storyline which combines text, characters, audio, video, effective interactive quizzes and virtual laboratories using drag and drop features. This application is effective for teaching abstract, process and difficult to reach materials. Articulate Storyline has a similar appearance to power point, with almost the

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same design, movement and animation features. However, Articulate Storyline is equipped with data scripts and can be published in HTML5, CD, .swf and website formats so that it can be accessed via smartphones or laptops without requiring in-depth programming skills. Articulate storyline is a product of Articulate 360 which was released in 2001 as a presentation support tool. Although this software has been released for a long time, there are still many teachers who do not know about this interactive multimedia. Pratama (2018), Daryanes et al. (2023), and Arwanda et al. (2020) shows that interactive learning media with articulate storyline on cellular respiration material can improve students' problem-solving abilities. Research conducted by Rafmana et al. (2018), and Hidayah et al. (2023) showed that the field test stage of learning media based on Articulate storyline can increase student learning motivation by 82.1%.

Biotechnology is a branch of biology that studies scientific principles using organisms such as bacteria and fungi to produce products that are useful for everyday life. For junior high school level, biotechnology material focuses on the introduction of conventional and modern biotechnology, examples of its applications and the types of microorganisms used. According to Riani et al. (2013) biotechnology material is relatively difficult because it is applicative and abstract so that it requires a correct understanding of basic concepts. Purwianingsih (2009), and Rahmawati et al. (2023) revealed factors that limit biotechnology teaching including: lack of teacher expertise in mastering the material, lack of experience in the suitability of teaching activities, lack of sources and curriculum materials and lack of teaching time. In biotechnology, the integration of the application of concepts with direct experience through practicums is very important.

Laboratory practicums provide students with the opportunity to gain hands-on experience in conducting experiments, develop critical thinking skills, and hone problem-solving skills. However, according to Bonde et al. (2014), De-Vries et al. (2019), Dyrberg et al. (2017), Conway-klaassen et al. (2012), Celine et al. (2023), Yuniarti et al. (2012), and Yildirim (2020) practical limitations such as costs, facilities, tools and materials, safety issues, and material complexity are often obstacles in implementing practicums. The results of initial observations and interviews related to Conventional Biotechnology practicums conducted by Science Teachers in Balikpapan showed that practicums on making tape, tempeh or yogurt were often carried out because they were easy and cheap. In addition to not requiring complicated tools and materials, starters in the form of yeast were also easy to obtain. However, the lack of challenges and updates to practicums from year to

year encouraged researchers to utilize fruit skin waste, namely pineapple (*Ananas comosus*) as conventional biotechnology practicum materials in schools. Through observations and interviews with science teachers at SMP Negeri 10 Balikpapan, the practicum tools and materials were incomplete, few in number and damaged due to lack of maintenance. The use of the Science Laboratory is not only used for practicums but also other activities such as school coordination meetings, class associations, spiritual worship so that students are limited to using it alternately. Therefore, researchers developed learning media with a virtual laboratory for making nata de pina (conventional biotechnology) based on the Articulate storyline.

## Method

### *Type of Research*

This research method uses a Research and Development (R&D) design with the ADDIE development model consisting of five stages, namely Analysis, Design, Development, Implementation and Evaluation.

### *Time and Place of Research*

The research was conducted at SMPN 10 Balikpapan, with a period of January - April 2024.

### *Research Subjects*

The research subjects were 71 students divided into 35 experimental classes and 36 control classes.

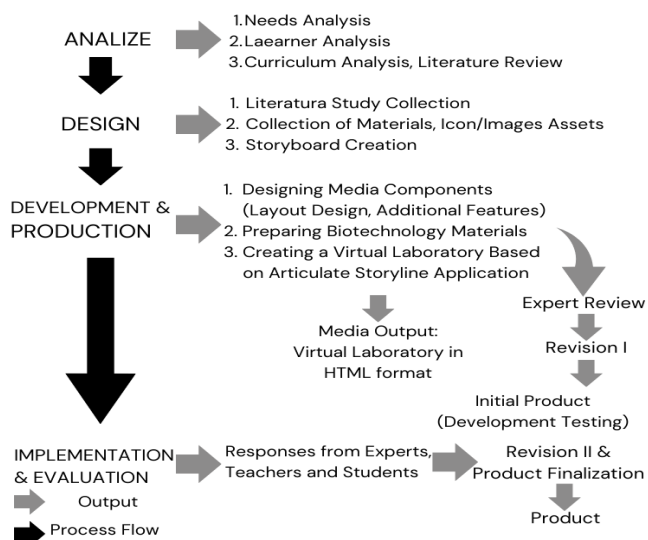
### *Procedure*

Data collection techniques used observation, interviews, documentation and tests. Data analysis techniques consisted of validity and practicality tests using percentages and product effectiveness tests using the N-Gain test. Observations and interviews were conducted to obtain data as an initial analysis to determine the needs of science teachers and students in the learning process. Documentation is used to collect data directly on the conditions and facilities of the science laboratory facilities and infrastructure at SMP Negeri 10 Balikpapan. The research flow is shown in Figure 1.

**Table 1.** Media Validity Assessment Criteria

Interval (%)	Criteria	Category
85.01 - 100	Very valid	Can be used without revision
70.01 - 85.00	Valid	Usable but minor revisions
50.01 - 70.00	Less valid	It is recommended not to use as it requires major revision
1.00 - 50.00	invalid	Not to be used

Quantitative analysis was obtained including data from collecting media expert and material expert test questionnaires, student response questionnaires to the media and student science process skills instrument tests. The following are the criteria for assessing the validity of the media developed.



**Figure 1.** Research design flow

The practicality response questionnaire from students was analyzed using the formula:

$$\text{Practicality} = \frac{\text{Total score for each question}}{\text{Number of respondents}} \times 100\% \quad (1)$$

With the criteria as shown in Table 2. The research instruments used were tests and questionnaires. The test instrument was used to measure students' Science Process Skills (SPS) through pretests and posttests in both control and experimental classes. There were 20 questions with indicators developed in accordance with SPS criteria, including; (1) observing, (2) predicting, (3) planning experiments, (4) using tools and materials, (5) applying concepts, (6) communicating. The questionnaire was used to collect data related to students' responses to the level of practicality of the

virtual laboratory media based on the articulate storyline. The questionnaire used a Likert scale with a value range of 1 to 4 (1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree).

**Table 2.** Media Practicality Criteria

Percentage (%)	Category
81 – 100	Very Practical
61 – 80	Practical
41 – 60	Quite Practical
21 – 40	Less practical
0 – 20	Not Practical

Data on students' initial science process skills were obtained through pretests in the experimental and control classes. The experimental class was given virtual laboratory media as a research object while the control class was not. Then the results of the pretest and posttest were used for hypothesis testing to determine the effectiveness of the media on science process skills (SPS).

## Result and Discussion

The virtual laboratory media developed can be accessed online via a link using a cellphone or laptop. The media is equipped with menu features including a virtual laboratory that can be adjusted to the needs of students. The following is a display of the virtual laboratory media based on Articulate Storyline developed by researchers.

Media validation was conducted by four lecturers, namely two lecturers as material experts and two lecturers as learning media experts. The validation results showed that the average percentage of the suitability of virtual laboratory media by experts was 88.79 with a very valid category. The media met the criteria in terms of appearance, suitability to learning objectives, content and practicality. However, there were several minor revisions needed to perfect the virtual laboratory media. The recapitulation of expert validation can be seen in Table 3.



**Figure 2.** Virtual laboratory media login page

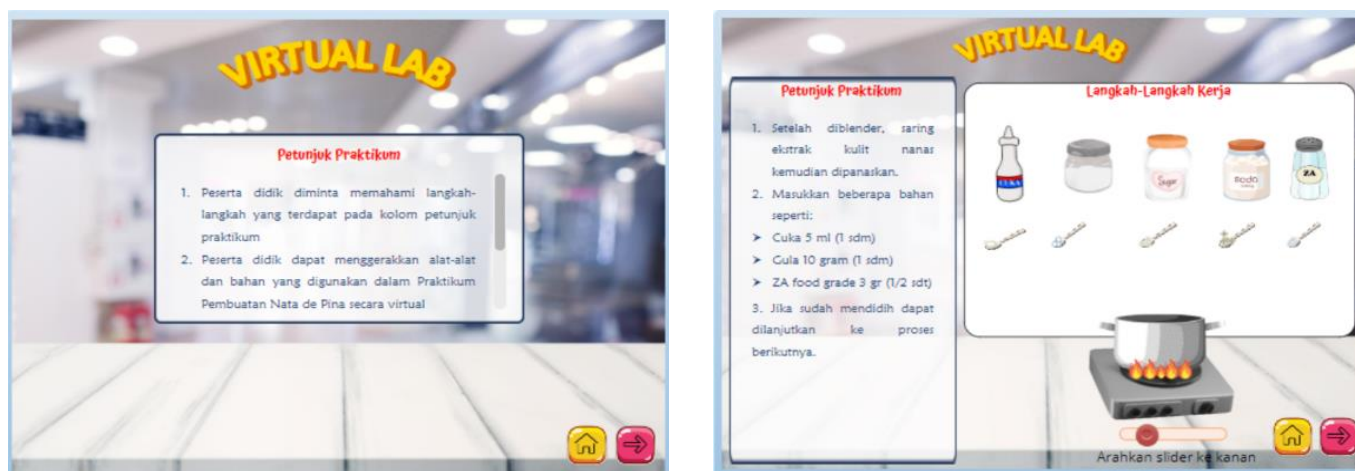


Figure 3. Virtual laboratory media display

Based on these results, it can be concluded that the test and questionnaire of student responses to the media are declared reliable and valid to be used as accurate data collection tools in research. After that, the research was continued by applying the media on a limited scale to see the effectiveness of the media that was tested on

10 grade IX students at SMP Kartika Balikpapan. The validity test of the test items was measured using the Pearson test with a significance level of 0.05. The test items are said to be valid if the calculated  $r > r_{\text{table}}$  (Arikunto, 2006). All test items are declared valid because they have a calculated  $r$  value  $> r_{\text{table}}$  (0.632).

**Table 3.** Validation Results of Material Experts and Media Experts

Assessment Aspects	Validator	Percentage (%)	Conclusion
Media: Usability, Audio (narration, sound effects, background sound), Visual (layout design, typography, attractive colors), and Interactive tools (navigation buttons, animations and drag and drop)	Media Expert I	93.06	Very valid
	Media Expert II	91.67	Very valid
Subject Matter: Clarity and suitability of material with Learning Outcomes (CP), Depth of Subject Matter, Systematic description of Subject Matter, and Use of easy to understand language	Subject Matter Expert I	79.55	Valid
	Subject Matter Expert II	90.91	Very valid
Average		88.79	Very valid

The results of the reliability test show that the Cronbach's Alpha value on the test is 0.668 so it is said to be quite reliable and the questionnaire has 0.929. Based on these results, it can be concluded that the test and questionnaire of student responses to the media are

declared reliable and valid to be used as accurate data collection tools in research.

The researcher has summarized several inputs and product revisions by the material and media validators in the following table.

**Table 4.** Virtual Laboratory Design Revision

Aspects	Revision
Subject Matter	
Clarity of learning objectives	KI, KD are replaced by writing CP, ATP and TP
Contextuality	The bibliography is given columns based on source, author and title
Depth of Subject Matter	The animated image of <i>Acetobacter xylinum</i> bacteria should use an image of real bacteria. Writing bacteria according to the rules for writing correct scientific names. The explanation of the meaning of biotechnology does not need to be underlined and bolded.
Clarity of description, discussion of examples, simulations and school exercises	In simulations, practical instructions do not need to use a scroller
Media	
Usability	Added a button to exit the application when finished
Audio (narration, sound effects, background sound)	The background sound when you first enter the application is replaced with one that is shorter and more appropriate in duration. There are additional sounds during the practical, flowing water and others.



With the transition from the 2013 Curriculum to the Independent Curriculum, core competencies (KI) are replaced with learning outcomes (CP) and learning objective flows (ATP). This can be seen in Figure 4. Based

on the media validator's suggestion regarding its reader usability, the bibliography writing format is separated based on the author, title and research source. This can be seen in Figure 5.



Figure 4. Revision of clarity of learning objectives

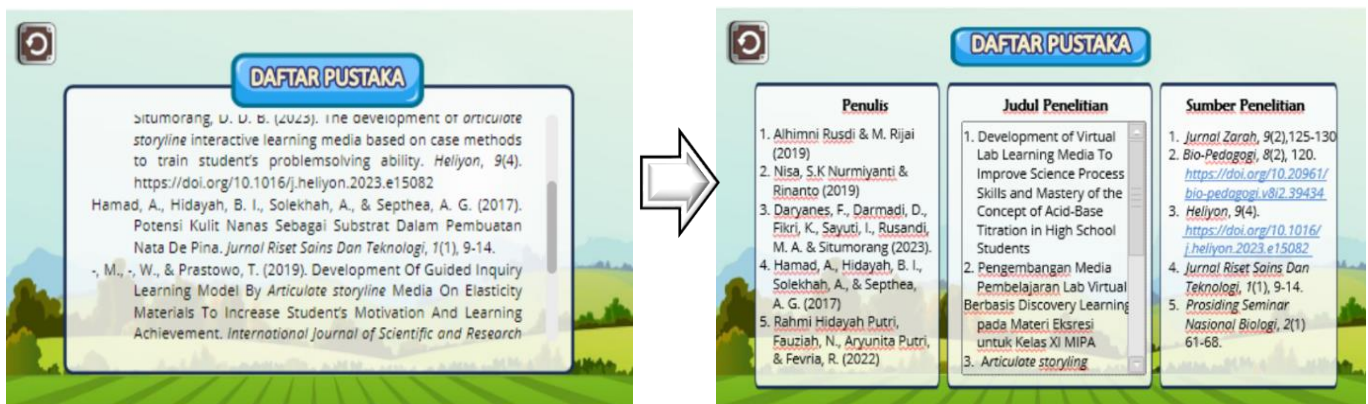


Figure 5. Revised bibliography writing format



Figure 6. Revised bacteria image

In the trial in the experimental class and control class, the following results were obtained regarding the improvement of science process skills (Table 5). Based on Table 5, in the aspect of planning experiments in the control class there was a decline. Meanwhile, for the experimental class there was an increase in all aspects of the observed SPS  $\geq 75$ .

Table 6 shows that the experimental class has an N-Gain of 0.61 in the medium category and the control class has 0.30 in the low category. The application of virtual laboratory media based on Articulate Storyline has quite an influence on students' science process skills in Biotechnology material but is not comprehensive.

**Table 5.** Analysis of Improvement of Science Process Skills (SPS)

SPS	Control Class		Experimental Class	
	Pretest (%)	Posttest (%)	Pretest (%)	Posttest (%)
Observing	66	66	55	80
Predicting	66	66	48	78
Planning an Experiment	66	57	44	85
Using Tools and Materials	54	54	33	78
Implementing the Concept	60	60	43	82
Communicating	43	43	30	75

**Table 6.** Gain Test Results in SPSS

Class	N	Pretest score	Posttest score	N-Gain	Category
Experiment	36	42.50	77.08	0.61	Medium
Control	35	43.86	60.14	0.30	Low

Virtual laboratory media based on Articulate Storyline developed by researchers with interactive tools, namely tool components for the interaction process by carrying out activities, using the drag and drop concept (picking up and putting down) or the play and pause concept (playing and pausing) Jaya (2020) but does not include a complete worksheet, only practical instructions without including filling in tables and data analysis so that students' understanding has not reached the analysis stage. The media has not presented the difference in pineapple concentration and pineapple skin as variables in the study so that students do not master the drawing of hypotheses or determining variables in the nata de pina making practicum. This is as conveyed by Muhajarah et al. (2020), Putri et al. (2022), Rusdi et al. (2021), Darmaji et al. (2022), Dewi et al. (2021), Kilani et al. (2018), Ekaputra (2023), and Ambusadi et al (2018) as a challenge in developing a virtual laboratory based on virtual technology skills.

Based on Table 7, students responded positively to the application of virtual laboratory media on this Biotechnology material for classroom learning, the media is very practical, the motivation and self-confidence of students to learn and share knowledge related to this material increased. All aspects of the assessment on the questionnaire distributed to students in the experimental class showed an average of 90.49 with very good criteria in terms of media practicality, material concepts, user satisfaction and self-confidence levels. At SMPN 10, learning with virtual laboratory media is very rarely done, so something new will attract students to be enthusiastic and motivate them in learning activities. Several studies related to the

application of virtual laboratory media show a positive trend, such as Ridwan et al. (2023), Bidaki (2018) Wijayanto et al. (2018), Widowati et al. (2017), Rohim (2020), Potkonjak et al. (2016), Herga et al. (2016), Faour et al. (2018), Dominguez et al. (2018), Dalgarno et al. (2009) and Kusmawan (2022) where the development of a virtual science laboratory with the theme of plant life processes increased students' learning interest by 89.14%. This shows that virtual laboratory media is not only effective in delivering material but is also able to increase students' enthusiasm and motivation to learn.

**Table 7.** Recapitulation of Student Responses to Media

Assessment Aspects	Average	Criteria
Media Practicality	90.97	Very good
Concept of Matter	92.36	Very good
User Satisfaction	87.67	Very good
Growing Self Confidence	90.97	Very good
Average	90.49	Very good

## Conclusion

The use of Virtual Laboratory media in Grade IX Biotechnology Material significantly improves Science Process Skills (SPS) compared to conventional learning. The results of the N-Gain test showed that the experimental class that implemented the virtual laboratory had a higher increase in science process skills compared to the control class. Science Process Skills which include the process of observation, predicting, planning experiments, using tools and materials, applying concepts and communicating research results experienced an increase of 80, 78, 85, 78, 82, and 75% respectively, including the high category.

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## Author Contributions

Conceptualization, investigation, writing—original draft preparation, and methodology, R.M., E.T.M., and D.; validation, formal analysis, and resources, A.H., Y.H., and L.S.; data curation, writing—review and editing, and visualization, M., H., and K.P.C. All authors have read and agreed to the published version of the manuscript.

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## Conflicts of Interest

The author declares no conflict of interest.

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