Developing digital learning media of Artsteps virtual exhibition on food chain material

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Abstract: The low student learned outcomes on the topic of food chains, as well as the less varied instructional media used by teachers, was the background of this researched. This researched aimed to developed, assess the feasibility, and tested the effectiveness of the Artsteps Virtual Exhibition learned media in enhancing learned outcomes on food chain material for fifth-grade students at one of elementary school in Semarang City. This typed of researched researched and development (R&D) utilizing the Borg and Gall development model, which consisted of 10 stages. However, the researcher only reached stage 9. Subject mattered experts and media experts conducted the product validity tested. The results of this researched included the development process of artsteps learned media on the topic of food chains; the validity of Artsteps learned media, which assessed as highly valid from students' responses to Artsteps learned media fell into the category of excellent; and the SPSS result indicating a significant difference in outcomes before and after the treatment. Therefore, Artsteps learned media could improved students' learning outcomes on food chain material.

Keywords: Artsteps; food chain; learning media; learning outcomes

1. Introduction

Technology is a development resulting from scientific knowledge, which will continue to be updated within the field of education. Currently, technology is rapidly advancing alongside the progress of science and the habit of using technology (Aivazidi & Michalakelis, 2023). The progress and development of this technology must be maximally utilized, especially in the field of education, particularly in elementary schools. Because schools are responsible for preparing the next generation for life after formal education, teachers are expected to develop students' technology literacy, defined as individuals' understanding of technology at a level that enables them to function effectively in a modern technological society (Lidolf & Pasco, 2020). The education sector has entered an era of learning that utilizes technology, especially in learning media. Media use in learning can spark new interests, increase motivation and stimulation in learning activities, and even psychologically affect children (Puspitarini & Hanif, 2019). Engaging media has become necessary for teachers to motivate students in teaching and learning (Annisa & Simbolon, 2018). Therefore, a teacher must be able to utilize technology as a teaching aid or medium.

In the "Merdeka Belajar" curriculum, there is a subject called "Ilmu Pengetahuan Alam dan Sosial" (IPAS) or Natural Sciences and Social, which is taught starting from the upper grades, namely Grade 4 of elementary school. This updated curriculum has a new feature compared to the previous curriculum, where science and social studies are integrated into IPAS. The aim of IPAS learning in this curriculum is to develop inquiry skills, understanding of oneself and the environment, and knowledge and concepts in learning (Nuryani et al., 2023; Dwi & Erita, 2023). Natural Sciences and Social Sciences

(IPAS) is a field of study that examines living organisms and inanimate objects in the universe and their interactions, and it also examines human life both as individuals and as social beings who interact with their environment (Wijayanti & Ekantini, 2023; Failasufah & Setyasto, 2023). IPAS needs to present contexts that are relevant to the natural conditions and environment surrounding the students (Alfatonah et al., 2023). IPAS helps student cultivate their curiosity about the phenomena around them (Rohman et al., 2023; Hasanah et al., 2023; Nanda et al., 2023). Students' understanding of the universe's workings and how it interacts with human life on Earth is likely inspired by their curiosity. Such understanding can be utilized to identify various challenges and find solutions to achieve sustainable development goals (Sartika et al., 2023; Rahmawati et al., 2023).

Based on the results of observations and interviews conducted with fifth-grade teachers at Sampangan 02 National Elementary School in Semarang City, it was found that students need help understanding the subjects of natural sciences and social sciences, particularly food chain material. During the lessons, students feel bored and end up not paying attention to the material presented by the teacher. Additionally, the teachers only utilize learning media such as printed books, LCD projectors, and other simple media. Limited media use makes students feel bored and less engaged in the learning process. Therefore, there is a need for creative and innovative learning media to help students understand food chain material.

Learning media is a tool used to convey messages and can be utilized within the education system. Learning media is defined as physical or non-physical tools teachers use to deliver material to students more effectively and efficiently (Gutmann et al., 2015). Learning media is defined as physical or non-physical tools teachers use to deliver material to students more effectively and efficiently. Learning media is used to support the learning process to achieve learning objectives (Puspitarini & Hanif, 2019). The application of learning media in elementary schools is a meaningful initiative to reduce monotonous teaching practices (Widyaningrum et al., 2022; Izhar et al., 2023). The selection of the type and content of learning media considers the level of students' thinking, prioritizes the principle of reading for pleasure, and adapts to the material and learning objectives (Kadek et al., 2021). One platform that can be used as a learning media is Artsteps Virtual Exhibition (Cruz & Torres, 2022).

Artsteps is an online platform that can organize virtual and interactive exhibitions in a web-based environment, allowing showcased works to be viewed by others using Internet access (Dumitrescu et al., 2014). Virtual exhibitions can be defined as web-based online collections of hypermedia or multi-dimensional information that is captured or dynamically rendered and grouped into specific themes, concepts, topics, or ideas (Almurbati, 2021; Arslan & Ari, 2021; Ade et al., 2023). The Artsteps technology facilitates users in creating three-dimensional virtual exhibition spaces for both interior and exterior environments, and it can provide a more realistic impression with Virtual Reality (VR). Virtual Reality (VR) is an expanding technology that provides computer-generated simulation of an environment that can be interacted with in what appears to be real-time (Lege & Bonner, 2020; Marougkas et al., 2023). This platform offers a new experience where visitors feel like they are in a physical gallery and can walk around (Setiawan et al., 2022). Although Artsteps is specifically designed for art and culture, there are still several ways the platform can be utilized as a learning media for IPAS. With creativity and adaptation, this platform can enrich the learning experience in IPAS subjects. One example is using Artsteps as a learning media for food chain material, which can facilitate students' understanding of the material because the platform provides an experience similar to visiting an exhibition, giving a more realistic impression to students. This exhibition can include images, videos, and descriptions that help students understand the concepts, making them more engaged during learning.

After the state of the art of previous research survey in grade 5 elementary school on science learning, students felt bored quickly and paid less attention to learning due to the use of less interesting learning media. For this reason, researchers developed learning media in the form of art steps to help make learning interesting. Few researchers focused on developed this media. There have been limited studies concerned on this artsteps learning media. There is limited research related to artsteps learning media but only focuses on the material to be delivered and does not include things that can trigger students such as quizzes at the end or games. Therefore, this research was aimed to assess the feasibility of the Artsteps learning media on food chain material. This research is likely to help and facilitate fifth-grade elementary school students in understanding the food chain material.

2. Materials and Methods

The research design is a guideline or is a procedure used by researchers as a guide in conducting research. The type of research used by the researcher is Research and Development (R&D) research. R&D research helps create or develop product designs, conduct the production process, and test the product's effectiveness (Richey & Klein, 2005; Sugiyono, 2021). Meanwhile, the development model used in this research is the Borg and Gall development model (Borg & Gall, 1983) research and development is a method or process used to validate and develop a product. The sequence of actions in Borg and Gall includes potential problems, data collection, product design, design validation, design revision, preliminary testing, product revision, field testing, final product revision, and mass production (Aka, 2019). However, the researcher only reached the ninth step in this study, revising the final product.

The subjects of this study are fifth-grade students of Sampangan 02 National Elementary School, Semarang City. The total population of fifth-grade students is 36 students. The sampling technique used is purposive sampling, which is sampling based on specific objectives (Firmansyah et al., 2022). The research procedure involves developing the Artsteps Virtual Exhibition learning media, where the evaluation process primarily consists of assessing teacher responses, which serve as a benchmark for the success of the development. Product data analysis consists of two parts: analysis of teacher and student needs questionnaires and analysis of teacher and student responses to the developed media.

The analysis of teacher and student needs questionnaires uses the Guttman scale with yes or no options. The scale range used is 1 (yes), and the value is 0 (no). We follow the provisions of Arikunto (2014) as in Formula 1, while Criteria for Teacher and Student Needs Questionnaire are as in Table 1.

$$P = \frac{\Sigma x}{\Sigma xi} \times 100 \tag{1}$$

Information :

P = score percentage

Σx = total score of respondents' answer for one item

Σxi = ideal score count for one item

Table 1. Criteria for Teacher and Student Needs Questionnaire

Percentage (%)	Criteria
81% – 100%	Strongly agree
61% – 80%	Agree
41% – 60%	Disagree less
21% – 40%	Disagree
0% – 20%	Strongly disagree

Analysis of teachers and students responses to learning media using the Likert scale consists of 5 categories: 1 (strongly disagree), 2 (disagree), 3 (quite agree), 4 (agree), and 5 (strongly agree). We follow the provisions of Arikunto (2014) as in Formula 2, while Teacher Response Questionare Criteria are as in Table 2.

$$P = \frac{\Sigma x}{\Sigma x i} \times 100 \tag{2}$$

Information :

P = score percentage
Σx = total score of respondents' answer for one item
Σxi = ideal score count for one item

Table 2. Teacher Response Questionare Criteria

No.	Score Percentage (%)	Criteria	Information
1.	81% – 100%	Excellent	The media is very feasible, it doesn't need to revision
2.	61% – 80%	Good	The media is acceptable, it doesn't need revision
3.	41% – 60%	Good enough	The media is not quite acceptable needs revision
4.	21% – 40%	Not good	The media isn't acceptable needs revision
5.	< 20%	Very unfavorable	The media is highly unacceptable needs revision

The questionnaire measures students' responses to media using the Guttman scale with yes or no options. The scale's value range is 1 (yes) and 0 (no). We follow the provisions of Arikunto (2014) as in Formula 3, while Student Response Questionnaire Criteria are as in Table 3.

$$P = \frac{F}{N} \ x \ 100 \tag{3}$$

Information:

P = percentage value of interest in learning using media
F = the frequency being sought for its percentage
N= the maximum score total

Table 3. Student Response Questionnaire Criteria

No.	Score Percentage (%)	Criteria
1.	81% – 100%	Very interesting
2.	61% – 80%	Interesting
3.	41% – 60%	Enough interesting
4.	21% – 40%	Less attractive
5.	< 20%	Unattractive

The effectiveness of the results before and after treatment carried out by students can be analyzed on students' cognitive learning outcomes by calculating the scores that students have obtained and testing the results before and after treatment. Finding out if the residual or confounding variables in the regression model have an abnormal or normal distribution is possible with the normality test (Alfatonah et al. 2023). The normality test aims to determine the type of statistics in data processing. In this study, researchers used SPSS version 22 to determine normality the Shapiro-Wilk methode used. The Normality Test Testing Criteria as in Table 4, according to Priyatno (2018).

Table 4. Normality Test Testing Criteria

Result	Information
If the significance value is ≤ 0,05	Ho rejected
If the significance value > 0,05	Ho accepted

The t-test or t-test using the *paired sample t-test* method in final data analysis functions to test hypotheses involving averages as a benchmark/indicator or an effort to compare the averages of two variables combined in one group. In this study, researchers used SPSS version 22 using the *paired samples t-test method*. Data treated with *paired sample t-test* must have a normal distribution. The Testing Criteria Paired Samples T-Test as in Table 5 and the Decision Making Based on the Significance of the Paired Samples T-Test as in Table 6, according to Priyatno (2018).

Table 5. Testing Criteria Paired Samples T-Test

Result	Information
If -t calculate or greateror ≥ t calculate t table ≤	Ho accepted
If -t calculate -t table less < t calculate t table	Ho rejected

Table 6. Decision Making Based on the Significance of the Paired Samples T-Test

Result	Information
If the significance value is ≤ 0,05	Ho rejected
If the significance value > 0,05	Ho accepted

Next, the N-Gain test was carried out, which was used to calculate the assessment between the pre-test score and the post-test score. The normalization of the gain gained by comparing the difference between the Ideal Minimum Score (SMI) and pre-test on food chain material after utilizing Artsteps learning media is known as the N-Gain test. We follow the provisions of Arikunto (2014) as in Formula 4, while N-Gain Score Criteria are as in Table 7.

$$N - Gain = \frac{SPost - SPre}{SMax - SPre}$$ (4)

Information:
N-Gain= N-Gain score
SPost= post-test score
SPre= pre-test score
SMax= maximum score

Table 7. N-Gain Score Criteria

Interval	Criteria
N-Gain ≥ 0,7	High
0,3 ≤ N-Gain ≤ 0,7	Medium
N-Gain < 0,3	Low

3. Results

This research is research regarding the development of Artsteps Virtual Exhibition learning media on science and technology learning content on food chain material carried out at Sampangan 02 National Elementary School, Semarang City. Several aspects were examined from the results of this research, including (1) the development outcomes of the Artsteps Virtual Exhibition learning media, (2) the assessment of the feasibility of the Artsteps Virtual Exhibition learning media, and (3) the effectiveness of the Artsteps Virtual Exhibition learning media.

3.1 Product Data Analysis

3.1.1 Analysis of Teacher and Student Needs Questionnaires

Table 8 is the results of the teacher and student needs questionnaire. Table 8 shows the average results for the development of Artsteps learning media at 87.5% or included in the strongly agree criteria.

Table 8. Teacher and Student Needs Questionnaire Results

Subject	Percentage (%)
Teacher	84%
Student	91%
Average	87.5%

3.1.2 Analysis of Teacher and Student Responses to Media

The results of teacher responses to Artsteps learning media can be seen from the results of the teacher response questionnaire in Table 9. Table 9 shows an average result of 91%. Based on the criteria, this is included in the very feasible criteria and without revision.

Table 9. Teacher Response Questionnaire Results

Teacher	Percentage (%)
Class A Teacher	90%
Class B Teacher	92%
Average	91%

The results of student responses to Artsteps learning media can be seen from the results of the teacher response questionnaire (Table 10). The results of responses from students are obtained from small trial and large trial activities, and then the average of the student response questionnaire results is found. The average obtained from student responses was 95% and was included in the very interesting criteria. Based on student responses, it was stated that the Artsteps learning media made students feel happy and able to understand the food chain material.

Table 10. Student Response Questionnaire Results

Results of Small Scale Trials	Results of Big Scale Trials	Average
94%	96%	95%

3.2 Initial Data Analysis

3.2.1 Normality Test

The normality test is used as a tool to find out whether data is normally distributed or not. Normally distributed data will use parametric statistical techniques. In this case, the data tested are pre-test and post-test scores on small and large scales. Researchers used the Shapiro-Wilk method assisted by the SPSS 22 application (Table 11).

Table 11. Normality Test Results in Small Scale Trials

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Before	.180	6	.200*	.920	6	.505
After	.202	6	.200*	.853	6	.167

The Table 11 shows the normality test results on small-scale trial activities. Normality is proven in the Shapiro-Wilk table by obtaining Sig. (significance value) before value

0.505 > 0.05 and after value 0.167 > 0.05. Thus, all the data above can be used for further data analysis, namely the t-test.

The Table 12 is about the results of normality tests in large scale trial activities. Normality is proven in the Shapiro-Wilk table by obtaining Sig. (significance value) before value 0.269 > 0.05 and after value 0.128 > 0.05. The paired sample t-test is fulfilled because the normality test results show that the data is normally distributed.

Table 12. Normality Test Results in Big Scale Trials

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Before	.151	30	.080	.958	30	.269
After	.141	30	.131	.945	30	.128

3.2.2 T-Test

Based on the data presented in Table 13, it shows the results of the t test on a small scale trial with a Sig value. (2-tailed) 0.012 < 0.05, so that H_0 is rejected and Ha is accepted, it can be concluded that the data from the small scale trial significantly differs in the results before and after treatment. In other words, the use of Artsteps learning material was discovered to increase the learning outcomes of fifth-grade elementary school students.

Table 13. T-Test Result in Small Scale Trials

	Paired Differences					t	df	Sig.(2-tailed)
	Mean	Std. Deviation	Std.Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair1 Before-After	-36.667	23.381	9.545	-61.203	-12.130	-3.841	5	.012

The data presented in Table 14 shows the results of the t-test on a large-scale trial with a Sig value. (2-tailed) 0.000 < 0.05, so that H_0 is rejected and Ha is accepted. Concluded that from the data from large scale trials, there is a significant difference in the outcomes before and after treatment. Based on the results after this treatment show that students' scores increased after using Artsteps learning media. So, the conclusion is that Artsteps learning media can improve student learning outcomes in food chain material.

Table 14. T-Test Result in Big Scale Trials

	Paired Differences					t	df	Sig.(2-tailed)
	Mean	Std. Deviation	Std.Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair1 Before-After	-20.467	14.029	2.561	-25.705	-15.228	-7.991	29	.000

3.2.3 N-Gain Test

The N-Gain test was conducted to see the average increase before and after treatment (Table 15). N-Gain is a normalized gain obtained by comparing scores before and after treatment with the difference between SMI and before treatment. N-Gain is an increase in

the average learning outcomes in presentation and data collection material after using the Artsteps Presentation and Data Collection learning media. Based on the results of the calculation of the average increase (N-Gain) in the small scale trial, it is known that there was an average increase of 0.59, which is included in the medium criteria.

Table 15. N-Gain Test Results in Small Scale Trials

	N	Minimum	Maximum	Mean	Std. Deviation
NGain	6	.25	.88	.5954	.25120
Valid N (listwise)	6				

Based on the results of the average increase test calculation (N-Gain) in the big scale trial as in Table 16, it is known that there was an average increase of 0.56, which is included in the medium criteria.

Table 16. N-Gain Test Results in Big Scale Trials

	N	Minimum	Maximum	Mean	Std. Deviation
NGain	30	-.09	1.00	.5686	.32305
Valid N (listwise)	30				

The Artsteps products can be seen in the following figure. Figure 1 is about initial exhibition view, Figure 2 is about media usage instructions, and Figure 3 is about top View of the Exhibition.
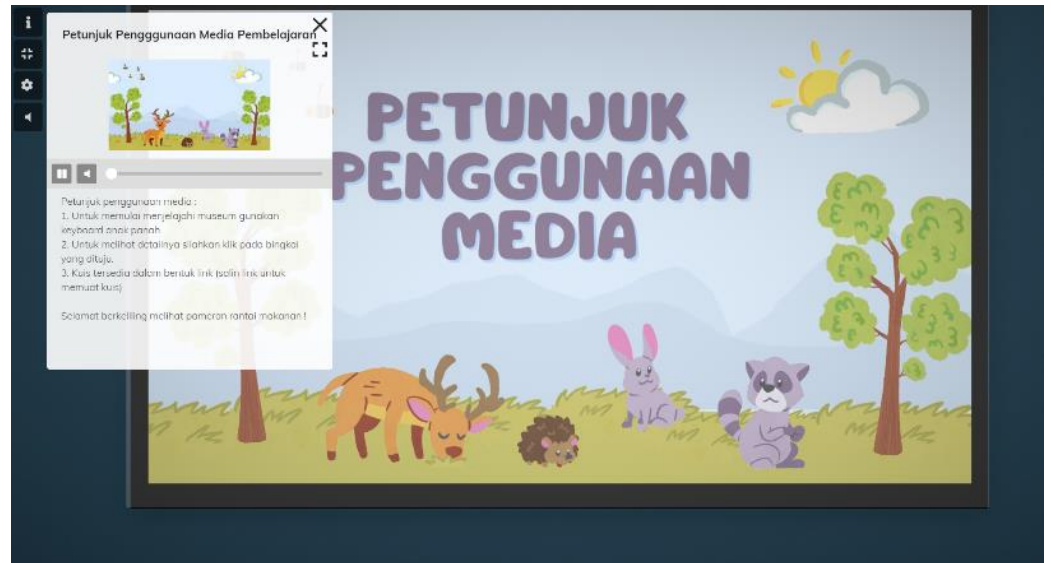

Figure 1. Initial Exhibition View
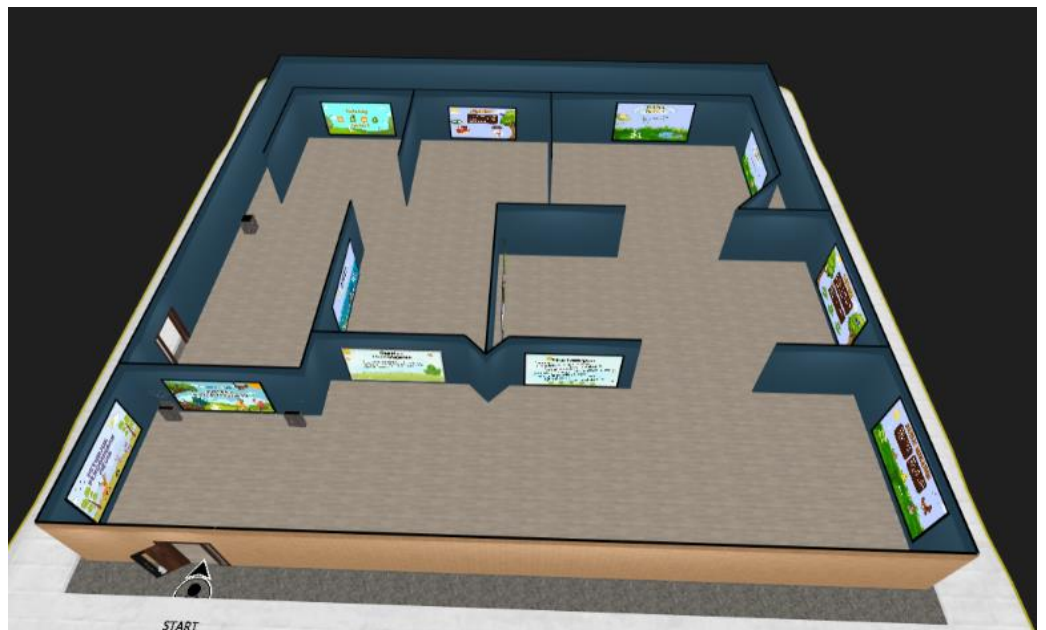
Figure 2. Media Usage Instructions

Figure 3. Top View of the Exhibition

Media expert validators and material experts also test the feasibility of Artsteps learning media. The data obtained from the learning media feasibility test results are as in Table 17.

Table 17. Artsteps Learning Media Feasibility Test Results

Validator	Score Percentage (%)	Criteria
Media	92%	Very valid
Material	88%	Very valid
Average (%)	90%	Very valid

4. Discussion

Learning media is a tool used to convey messages and can be used in the education system. Learning media is defined as tools in physical and non-physical form that teachers use to relate material to students to make it more effective and efficient (Gutmann et al.,

2015). he learning media created must continue to develop and be adapted to students' conditions. Developing media in every lesson is an important thing for a teacher to do. Because with the help of learning media it can attract students' attention during learning.

The selection of the type and content of learning media considers the level of students' thinking, prioritizes the principle of reading for pleasure, and adapts to the material and learning objectives (Kadek et al., 2021). One platform that can be used as a learning media is Artsteps Virtual Exhibition (Cruz & Torres, 2022).

Utilizing Artsteps media presents a viable solution to increase the efficiency of food chain learning. This research proposes the development of digital learning media on food chain material, where food chain is a subject in the high class, namely class 5 elementary school. The method used is Research and Development (R&D), involving media experts, material experts, class teachers and students as research subjects to test validity.

It is proven that the development of Artsteps digital learning media on food chain materials is feasible for use in learning. Consistent with prior research by Setiawan et al., (2022) that Artsteps digital learning media is engageable for students. This finding is further supported by Wahyu et al., (2023) research, showing that the feasibility of digital artsteps learning media has a very good category and interpretation is very suitable to be used as a learning media.

Information on the problems was obtained through observations and interviews conducted in class V of Sampangan 02 National Elementary School, Semarang City. It is known that students feel bored and less interested in studying a learning topic. Apart from that, the learning media teachers use during learning does not help students understand the learning material.

Data was obtained in developing Artsteps learning media in Natural and Social Sciences subjects on food chain material through observation, interviews, and qualitative teacher and student needs questionnaires. Data on the feasibility of Artsteps learning media on food chain material was obtained through a validation questionnaire from material and media experts, which was analyzed qualitatively. Data on student responses to Artsteps learning media on food chain material was obtained through qualitative questionnaires. Data on increasing student learning outcomes before and after media use were analyzed quantitatively using the normality test, t-test, and n-test using SPSS.

The design for developing Artsteps learning media is to improve learning outcomes in food chain material was based on the results of a teacher and student needs questionnaire, developed with the learning objectives contained in the independent curriculum and adapted to student needs. The steps for creating Artsteps learning media designs are divided into several stages including 1) Determining the theme in Artsteps; 2) Assessing the learning outcomes and goals to be achieved in class V of Elementary School; 3) Creating product designs in layout form; 4) Arrange displays or presentations in Artsteps; 5) Create coverings starting from the background, background sound, and attractive Artsteps coloring according to the needs from students; 6) Create a guide for using Artsteps learning media. Learning media was created using the website https://www.artsteps.com/, which is a platform used to create virtual exhibitions (Aranguren et al., 2023). This virtual exhibition gives a more real impression to students. This exhibition can include images, videos, and descriptions that help students understand the material and be more interested during the learning process. Then, content editing is done using the Canva application to create a more attractive Artsteps appearance with a combination of appropriate colors. Artsteps media takes the form of product output with a 3D virtual exhibition. The resulting Artsteps can be accessed like walking through a museum exhibition, which can be run according to directions (Ştefan et al., 2022). Learning media can be accessed via this URL https://www.artsteps.com/view/65ae202bf1204b8298908cab.

A percentage value of 90% is obtained based on calculations using the validity formula. According to the validity criteria table, the final validation value for Artsteps

learning media falls into the value range of 85.1% - 100% with very valid validation level criteria.

A small scale trial using 6 class V students of Sampangan 02 National Elementary School, Semarang City, as research subjects. The small scale trial began with working on pre-test questions before using the Artsteps learning media, then continued with trialing the Artsteps learning media while learning Natural and Social Sciences lesson content on food chain material. After that, students were given post-test questions, then students filled out a student response questionnaire regarding the implementation of learning activities and ended with providing an evaluation. The atmosphere during the learning process is pleasant, and communication between teachers and students occurs in two directions. This is proven by the results of the student questionnaire response of 94%, which falls into the very good criteria.

The large scale trial used 30 fifth-grade students at Sampangan 02 National Elementary School, Semarang City, as research subjects. The results of the student response questionnaire showed very good results, with an average of 95%. This average was obtained from the student response questionnaire on the results of previous small scale trials of 94% and the results of large-scale trials of 96%.

This research has developed Artsteps learning media on food chain material. After analyzing the results of the expert validator test results, the material expert's score was 92%, and the media expert's score was 88%. This shows that the Artsteps learning media is suitable for learning food chain material.

5. Conclusions

The development of Artsteps learning media on food chain material has been carried out in this research up to step 9 in the Borg & Gall development research method, namely revising the final product. After analyzing the expert validator test results, the material expert score was 92%, and the media expert got 88%, included in the very valid category, and Artsteps learning media was declared suitable for use. The results of the teacher and student response questionnaire with an average final score of 93% are included in the very good category, and this shows that the user response (teachers and students) is very good in using Artsteps learning media during the learning process. There is a difference in the average learning outcomes before and after using the Artsteps learning media in small-scale and large-scale trials, namely the t-test; in the small-scale trials, it shows a sig value. (2-tailed) 0.012 < 0.05, then in large-scale trials, it shows a sig value. (2-tailed) 0.000 < 0.05, this proves the positive influence of the development of Artsteps learning media on learning outcomes. Therefore, it can be said that learning outcomes before and after utilizing Artsteps learning media change significantly.

Based on the research and development conducted by Artsteps, the development of learning media in the following research is limited to only one material, namely food chain material, so it is recommended that future researchers develop the content of the material in the Artsteps learning media which was developed so that it is not limited and can be broader in scope so that it can add knowledge and make improvements to student learning outcomes in IPAS (Natural Science and Social Science) learning content.

Conflicts of Interest: Authors declare there are no conflicts of interest.

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