Canva Application-Based Learning Media: Improving Mathematics Learning Outcomes in Fraction Materials for Elementary School Students

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Abstract: The purpose of this study was to produce a suitable and effective Canva application-based mathematics learning medium for improving student learning outcomes at Betania Private Elementary School in Medan. The type of research used is ASSURE research and development. The research instruments used were initial needs questionnaires, material expert validation questionnaires, media experts, design experts, and student response questionnaires. This study also uses quantitative data analysis techniques (data on the feasibility and effectiveness questionnaire assessment) and qualitative data (observation data and documentation). Product validation results show a score percentage of 89.16% for material expert validation, 83.47% for media expert validation, 95% for design expert validation, and 98.75% for student responses. The results of the normality and homogeneity tests show that the research data has been declared normal and homogeneous. The results of the hypothesis test show that the value of t count is 1.98 and the value of t table is 1.66, where t count > t table. The results of this study indicate that Canva-based mathematics learning media are effective in improving student learning outcomes at Betania Private Elementary School, Medan.

Keywords: instructional Media; canvas; mathematics; fraction number

1. INTRODUCTION

The development and progress of science and technology are increasingly developing in the field of learning. By utilizing technology, the educational component of both teachers and students can easily obtain a lot of information so that they can learn and absorb it well. The use of information and communication technology in education is through the development of appropriate and interesting learning media [1]. One lesson that requires learning media so students can learn abstract material is mathematics. Mathematics is knowledge that plays an important role in various disciplines [2]. Mathematics is one of the subjects that must be taught in school, but mathematics is still considered difficult by most students.

According to Teni [3] "Learning media is a tool that can support the teaching and learning process so that the meaning and messages conveyed can be clearer and learning objectives can be achieved effectively". The use of learning media can encourage students to be interested in learning new things in the teaching materials that will be delivered by the teacher so that they are easy to understand. Interesting learning media for students can be a stimulus for the learning process. Management of teaching aids or media can be very helpful in the world of education. Learning media can be used as an aid in teaching and learning activities. One of the teacher's tasks is to be able to choose appropriate learning media to achieve learning objectives as planned.

Canva can help teachers create learning media and make it easier for them to explain subject matter. With this application, students can learn the material taught by the teacher more easily because Canva can display writing, video, sound, animation, pictures, charts, and others as needed and is able to help

increase student focus in learning activities because of its clear appearance. interesting [4]. The Canva application can help create designs without having to download the application and has various features that can combine various forms of artistic design [5]. The types of presentations that can be accessed on the Canva application are creative, educational, simple, business, marketing, sales, advertising, and technology presentations.

1.1 The Nature of Learning and Learning Outcomes of Mathematics

Suprijono [6] said that "Learning as a concept of gaining knowledge in practice is widely embraced. The teacher acts as a teacher who tries to provide as much knowledge as possible, and students actively collect or receive it. According to Kosasih [7] "Learning is a change in behavior that is marked by the existence of something new in a person, whether it is in the form of skills, attitudes, habits, knowledge, or skills". Learning is the result of an experience, namely in the form of interaction with environmental learning resources, books (readings) or people. Learning is an effort to acquire habits, knowledge, and attitudes.

According to Sanjaya [8], learning outcomes are learning behaviors, as learning outcomes are formulated in the form of abilities and competencies that can be measured or displayed through student performance. Learning outcomes cannot be separated from learning activities because learning activities are a process, while achievement is the result of the learning process.

According to Poerwanto [9], learning outcomes are processes within individuals that interact with the environment to obtain

changes in their behavior. Learning outcomes occur in individuals who want to learn, and there are changes in their skills, attitudes, and knowledge.

Furthermore, Slameto [10] suggests that learning outcomes are measured by the average results of the tests given, and the learning outcomes test itself is a group of questions or assignments that must be answered or completed by students with the aim of measuring student learning progress. Learning outcomes are "certain competencies or abilities, both cognitive, affective, and psychomotor, that are achieved or mastered by students after participating in the teaching and learning process" [11]. Learning outcomes are "changes that occur in students, both concerning cognitive, affective, and psychomotor aspects, as a result of learning activities" [12].

Daryanto and Raharjo [13] argue that mathematics can be learned to equip students at school with several competencies

so that they have the ability to think creatively, critically, analytically, systematically, and logically. So there must be good interaction between teachers and students in learning so that the goal is achieved, namely that students are able to understand and master the material. Meanwhile, according to Amir [14], learning mathematics is a series of planned activities in providing learning experiences that aim to acquire students who have learned mathematical knowledge, are skilled and intelligent, and are able to understand teaching materials well.

Fractional numbers are one of the numbers that we often encounter in mathematics lessons. In English, fraction means fraction, which comes from the Latin word fractus," which means broken. The definition of a fraction is a part of the whole of a certain quantity. Ordinary Fractions are a form of fraction where the value of the denominator is greater than the numerator or a/b where a is the quantifier and then b is the denominator (denominator > quantifier).
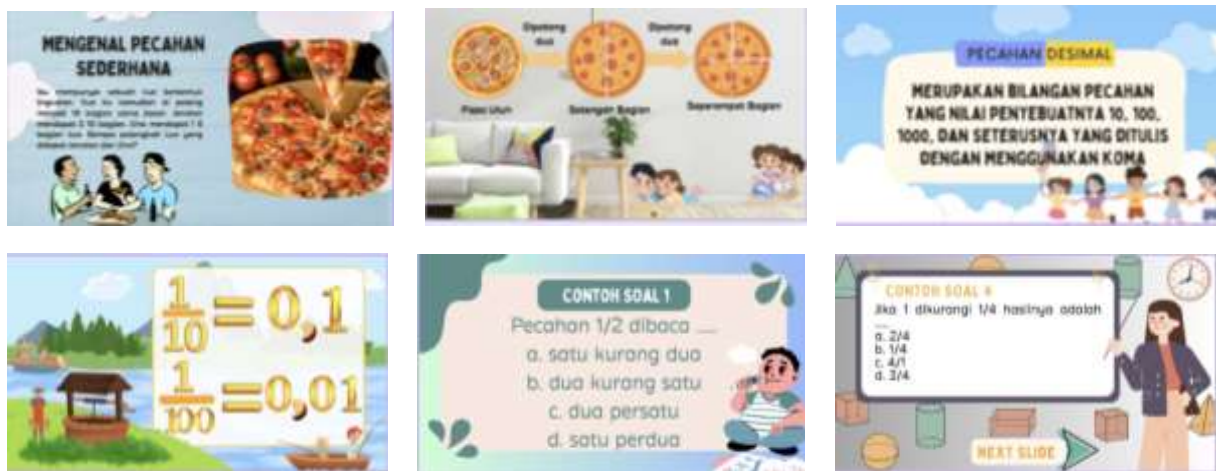

Figure 1. Display of class II elementary school math fraction material using the Canva application

1.2 The Nature of Canva Learning Media

Gagne [15] explains that media are various types of components in the student environment that can provide stimulation for learning. According to Purnamawati and Eldarni [16], media is anything that can be used to channel messages from senders to recipients so that they can stimulate students' thoughts, feelings, concerns, and interests in such a way that a learning process occurs. In addition, Bovee [17] stated that "Media is a tool that has the function of conveying messages".

According to the Association of Education and Communication Technology (AECT), media are all forms and channels used to convey messages or information, while the definition of media according to Djamarah [18] is any tool that can be used as a channel for messages to achieve learning objectives.

Learning is a translation of the word instruction," which in Greek is called instructus or intruere," which means conveying thoughts; thus, the meaning of instructional is conveying thoughts or ideas that have been processed in a meaningful way through learning [19].

The word learning contains a meaning that is more pro-active in carrying out learning activities because, in it, it is not only educators or instructors who are active, but students are active subjects in learning [20].

The definition of learning put forward by Gagne and Brigs [21] is a system that aims to assist the student learning process and contains a series of events that are designed and structured in such a way as to influence and support the internal student learning process.

Learning media is anything that can convey and distribute messages from sources in a planned manner so as to create a conducive learning environment where recipients can carry out the learning process efficiently and effectively [22].

Learning media is a message-carrier technology that can be used for learning purposes. Learning media is a physical means for conveying subject matter. Learning media is a means of communication in print as well as sight and hearing, including hardware technology [23].

According to Latuheru in Hamdani [24], learning media are materials, tools, or techniques used in teaching and learning activities with the intention that the process of educational communication and interaction with teachers and students can take place in an effective and efficient manner.

1.3 Media Canva

Canva is a web-based application that allows users to modify images and create graphic creations. Apart from that, users can also download other designs, such as themes, fonts, and photos, to enhance their creations. You can also use Canva to make

posters, flyers, and brochures, including educational media. According to Wulandari and Mudinillah [25], Canva is one of the most popular applications among teachers for making learning media. There are various interesting template features that can be used to create learning media and can be developed to design learning media as creatively as possible so that learning media has a more communicative meaning and the visualization of learning media is more attractive to students.

According to Raaihani [26], the advantages of the Canva application can be used to create learning media, including the following: (1) Having attractive graphic design template variants such as writing, backgrounds, musical instruments, images, animations, and so on; (2) training the creativity of teachers in making learning media, As well as having many functions that have been provided in the Canva application with the drag and drop feature; (3) Making learning media can save time; (4) Students can study the material that has been distributed by the teacher again.

According to Pelangi [27], he explained the benefits of Canva for teachers and students, namely Canva as a technology-based application that provides a learning space for teachers who carry out learning by relying on the learning media that Canva has applied. There are quite a lot of templates provided in the Canva application, such as PowerPoint, infographics, learning videos, and so on.

Figure 2. Display of the Canva application for making math plans and stories

The research problem is formulated as follows: (1) Is the mathematics learning media based on the Canva application developed suitable for use in fraction material for class III students at SD Betania Medan? Is the mathematics learning media based on the Canva application that was developed effectively used to improve the learning outcomes of class III SD Betania Medan?

2. METHOD

The research that will be carried out is a type of research on the development of Canva-based mathematics learning media. This type of research uses the Research and Development (R&D) method. According to Mulyana [28], R&D research is a type of research whose goal is to create and develop new products using certain steps. According to Hanafi [29], R&D research in education is a process used to create or develop a product that will be tested for validation or effectiveness.

This research was conducted at Batania Medan Private Elementary School, which is located at Jalan Tangguk Bongkar III No. 57, Tegal Sari Mandala II, Medan Denai District, Medan City. This research was conducted in the even semester of the 2022–2023 school year. The research subjects were third grade students at SD Betania Medan. As for class III A as the experimental class and class III B as the control class, The object in this study is the material Fractions.

The learning system design development model is the model put forward by Sharon E. Smaldino, James D. Russell, Robert Heinich, and Michael Molenda, namely the ASSURE model. The ASSURE model can be described in Figure 3 below:

Figure 3. ASSURE Model Development

The procedure in this study adopts the learning multimedia development model developed by Sharon E. Smaldino, James D. Russell, Robert Heinich, and Michael Molenda, namely the ASSURE model. The steps or stages of the ASSURE development model [30] are as follows: (1) Analyze Learners; (2) state Objectives; (3) Select Methods; (4) Utilize Media and Materials; (5) require Learner Participation; and (6) Evaluate and Revise.

Data collection was carried out using a questionnaire by distributing questionnaires to the respondents, namely material experts, media experts, design experts, and students. The respondents gave an assessment of the quality of Canva-based mathematics learning media with the following research criteria:

Table 1. Scoring Rules

No	Category	Score
1	Very good	5
2	Good	4
3	Pretty good	3
4	Not good	2
5	Not good	1

(Source: Arikunto, [31])

The research results of each respondent were used to calculate the average score obtained. The average score obtained is then converted into a qualitative value using the formula and basic guidelines to determine the level of validity as follows:

$$P = \frac{\sum x}{\sum x^1} \times 100\%$$

Keterangan:
P = Large Percentage
$\sum x$ = Number of Validator Answer Scores
$\sum x^1$ = Total Highest Answer Score

Table 2. Product Validation Criteria

Percentage %	Validity Level	Information
80 – 100	Very valid	Not Revised
60 – 79	Valid	Not Revised
40 – 59	Invalid	Partial Revision
20 – 39	Invalid	Revision
00 – 19	Very invalid	Revision

(Source: Arikunto, [32])

Canva Media Effectiveness Data Analysis
Normality test. To determine the average value, the formula is used, namely

$$\bar{x} = \frac{\sum f_i \, x_i}{\sum f_i}$$

To calculate the standard deviation (s), the formula is used, namely:

$$s = \sqrt{\frac{n\sum x_i^2 - \left(\sum x_i\right)^2}{n(n-1)}}$$

By testing criteria:
If Lo < Lt then sample is normally distributed and if Lo > Lt then sample is not normally distributed

Homogeneity Test. The examination of the variance homogeneity test aims to determine whether the sample data has a homogeneous variance or not. Test the homogeneity of variance using the F test, with the following hypotheses:
$H_0 : \sigma_1^2 = \sigma_2^2$ the two populations have the same variance.
$H_a : \sigma_1^2 \neq \sigma_2^2$ the two populations have different variances.

To test the hypothesis above, the following formula is used:
$$F_{hit} = \frac{var ians \; terbesar}{var ians \; terkecil}$$

Test Criteria are:
$F_{hit} < F_{tab 1/2 \, \alpha(v1, v2)}$, H_0 accepted
$F_{hit} > F_{tab 1/2 \, \alpha(v1, v2)}$, H_0 is rejected

Testing the hypothesis in this study was carried out using the one-party t-test formula where the statistical hypothesis being tested can be formulated as follows:
Ha: There are differences in the learning outcomes of students who study using learning media based on the Canva application and students who study with conventional learning media.
Ho: There is no difference in the learning outcomes of students who study using the Canva application-based learning media and students who study with conventional learning media.
To find out the significant differences of student learning outcomes. The t test formula is as follows:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

The test criteria are that Ha is accepted if tcount < ttable and Ho is rejected if tcount > ttable, which is obtained from the t distribution list with dk = (n - 1) and level α = 5%. To see the value of the effectiveness of the Canva application-based mathematics learning media that was experimented with, the effectiveness calculation formula was used as follow:

$$X = \frac{\text{number of students who completed}}{\text{total number of students}} \times 100\%$$

3. RESULTS AND DISCUSSION
3.1 RESULTS
The results of the assessment by media experts, material experts, individual trials, small group trials, and limited field trials for all aspects of the assessment are determined by the average score. The results of the assessment were then analyzed and determined whether or not it was appropriate to develop mathematics learning media based on the Canva application. The average percentage of the results of the assessment of media experts, material experts, individual trials, small group trials, and field trials is shown in Table 3 below:

Table 3. Feasibility of Canva application-based mathematics learning media

No	Categorization	Percentage of average score %	Criteria
1.	Material Expert Validation	89,16	very feasible
2.	Media Expert Validation	83,47	very feasible
3.	Learning Design Validation	95,00	very feasible
4.	Individual Trial	92,66	very feasible
5.	Small Group Trial	95,80	very feasible
6.	Field Test	98,75	very feasible
The average		92,47	very feasible

ased on Table 3 above, it can be concluded that the Canva application-based mathematics learning media is very feasible; thus, it is known that the average rating (µo) from experts and trials on students is 92.74%, while the eligibility threshold value criteria (µ) is 70%, so µo > µ. So it can be concluded that the Canva application-based mathematics learning media in this study is said to be very feasible to use and can meet the needs of implementing mathematics learning.

Based on the learning outcomes of students who were taught using the Canva application-based learning media at Betania Medan Private Elementary School, the lowest score was 70 and the highest score was 96. The average score was 83,875, mode 80, median 83.5, and standard deviation 6.871. A complete description of learning outcomes using the Canva application-based mathematics learning medium is shown in Table 4.

Table 4. Frequency Distribution of Experimental Class Student Learning Outcomes

Class	Class Intervals	Absolute Frequency	Relative Frequency
1	70 – 74	3	9,375%
2	75 – 79	6	18,75%
3	80 – 84	9	28,125%
4	85 – 89	5	15,625%
5	90 – 94	6	18,75%
6	95 – 99	3	9,375%
Total		32	100%

Based on the learning outcomes of students who were taught using conventional learning at Betania Medan Private Elementary School, the lowest score was 70 and the highest score was 95. The mean score was 80.531, mode 80, median 80.05, and standard deviation 6.619. A complete description of learning outcomes using conventional learning media is shown in Table 5.

Table 5. Frequency Distribution of Control Class Student Learning Outcomes

Class	Class Intervals	Absolute Frequency	Relative Frequency
1	70 – 74	3	9,375%
1	70 – 74	4	12,5%
2	75 – 79	7	21,875%
3	80 – 84	9	28,125%
4	85 – 89	6	18,75%
5	90 – 94	4	12,5%
Total		95 – 99	2

The data normality test uses the Liliefors test with the null hypothesis (Ho) which states that the sample comes from a normally distributed population. Acceptance and rejection (Ho) are based on a comparison of the price of Lcount with the price of Ltable at a significant level α = 0.05. If Lcount < Ltable then the data is normally distributed. Summary of data normality test results in the experimental class and control class can be seen in table 6.

Table 6. Summary of the Data Normality Test with the Liliefors Test

No	Data	Class	L_{count}	L_{table}	Conclusion
1	Pretest	Experiment	0,086	0,157	Normal
2	Pretest	Control	0,079	0,157	Normal
3	Posttest	Experiment	0,132	0,157	Normal
4	Posttest	Control	0,094	0,157	Normal

Based on table 6 it can be seen that the results of the pretest data normality test in the experimental class obtained Lcount < Ltable (0.086 < 0.157) and in the control class also obtained Lcount < Ltable (0.079 < 0.157). The same thing also happened to the posttest data normality test results for the experimental class with Lcount < Ltable (0.132 < 0.157) and in the control class obtained Lcount < Ltable (0.094 < 0.157). Thus, it can be concluded that the pretest and posttest data in the experimental and control classes were normally distributed at the significance level.

Homogeneity test was carried out to find out whether the data is homogeneous or not. To carry out the homogeneity test, Fisher's test is used, the sample has a homogeneous variance if

Fcount < Ftable at a significant level α = 0.05. The summary of the results of the data homogeneity test in the experimental class and control class can be seen in Table 7.

Table 7. Summary of Data Homogeneity Test with Fisher's Test

No	Data	Class	F_{count}	F_{table}	Kesimpulan
1	Pretest	Experiment	0,97	1,83	Homogeneous
2	Pretest	Control			
3	Posttest	Experiment	1,07	1,83	Homogeneous
4	Posttest	Control			

Based on table 7 it can be seen that the results of the calculation of the pretest data homogeneity test in the experimental class and control class at a significant level α = 0.05 obtained Fcount <Ftable (0.97 <1.83), it can be concluded that the pretest data in the two classes have the same or homogeneous variance. Then in the posttest data homogeneity test in the experimental class and control class at a significant level α = 0.05 obtained Fcount <Ftable (1.07 <1.83), it can be concluded that the posttest data in the two classes have the same or homogeneous variance .

Hypothesis testing in this study was carried out using the t test formula. The t-test was conducted to find out whether there were significant differences between learning outcomes in classes taught using the Canva application-based learning media (experimental class) and learning outcomes taught using conventional learning media (control class). The calculation results obtained tcount = 1.98 and ttable = 1.66 so that tcount > ttable at a significant level α = 0.05. Based on these results, that H0 is rejected and Ha is accepted or in other words there is a significant difference between student learning outcomes in the experimental and control classes at the significance level α = 0.05.

To test the effectiveness of the developed Canva application-based learning media, the following calculations are carried out:

$$X = \frac{number\ of\ students\ who\ complete}{total\ number\ of\ students} \ x\ 100\%$$
$$= \frac{27}{32} \ x\ 100\%$$
$$= 84,37\%$$

The value of the effectiveness of conventional learning media can be seen as follows:
$$X = \frac{number\ of\ students\ who\ complete}{total\ number\ of\ students} \ x\ 100\%$$
$$= \frac{21}{32} \ x\ 100\%$$
$$= 65,62\%$$

Based on the calculation of the effectiveness test on both, the results were obtained that the learning outcomes of students who were taught with the Canva application-based learning media were higher than the learning outcomes of students with conventional learning media (84.37% > 65.62%). Thus it can be concluded that the learning media based on the Canva application is more effectively used in learning mathematics at Betania Medan Private Elementary School compared to using conventional learning media.

3.2 DISCUSSION

Based on the results of the validation that has been carried out, the Canva application-based learning media product is declared feasible to continue in field trials. The learning media based on the Canva application that has been developed meets standards based on the design of the development of learning materials, learning media, and learning designs. And individual trials, small group trials, and field trials showed that the learning media based on the Canva application for learning mathematics were declared very suitable for use as learning media for Betania Medan Private Elementary School students.

Testing the effectiveness of the product on the developed Canva application-based mathematics learning media has been carried out by comparing the average value of student learning outcomes taught using the Canva application-based learning media with those using conventional learning media. There are differences in learning outcomes between students taught using learning media based on the Canva application and students taught using conventional learning media (84.37% > 65.62%).

This is in line with Santyasa [33], which states that the learning process should contain five communication components, namely the teacher (communicator), learning materials, learning media, students (communicants), and learning objectives. Learning media are all physical devices that can present messages and stimulate students to learn in the form of books, films, tapes, and so on [34].

Furthermore, Suryani [35] states that learning media are all forms and means of conveying information that are created or used in accordance with learning theory and can be used for learning purposes and convey messages, stimulate thoughts, feelings, attention, and willingness of students so as to encourage a learning process that is intentional, purposeful, and controlled.

Media Canva is a web-based application that allows users to modify images and create graphic creations. Apart from that, users can also download other designs, such as themes, fonts, and photos, to enhance their creations. You can also use Canva to make posters, flyers, and brochures, including educational media. According to Wulandari and Mudinillah [36], Canva is one of the most popular applications among teachers for making learning media. There are various interesting template features that can be used to create learning media and can be developed to design creative learning media so that learning media has a more communicative meaning and the visualization of learning media is more attractive to students.

Learning media using Canva can help make it easier for students to be more interested and motivated by the lessons conveyed in the media. According to Raaihani [37], the advantages of the Canva application are as follows: (1) It has an attractive variant of graphic design templates; (2) it can train teacher creativity in making learning media; (3) Making learning media can save time; and (4) Students can review material that has been distributed by the teacher.

This is also in accordance with Miarso's statement (in Mahnun [38]), which states that the first thing a teacher must do when using media effectively is to find, find, and choose media that meets children's learning needs, attracts children's interest, and is in accordance with developmental maturity and experience, as well as special characteristics that exist in the study group.

Furthermore, according to Purba [39], learning mathematics with the Canva application is very useful, and there is an increase in the ability to make mathematics learning media through the use of the Canva application in schools. According to Fadillah [40], Canva learning media is feasible to implement in class or independently by students. Then, according to Rohayati [41], learning innovation by utilizing technology in the form of the Canva application during the COVID-19 pandemic can improve student learning outcomes in elementary school mathematics.

Based on some of the explanations above, it can be concluded that the Canva application-based mathematics learning media can be called a good learning media if the learning media can improve student learning outcomes. The use of Canva application-based mathematics learning media allows students to more easily understand and master learning material.

4. CONCLUSION

1. The Canva application-based mathematics learning media product developed for Betania Medan Private Elementary School students meets the requirements and is suitable for use as learning media. This was concluded based on research results from learning material experts (89.16%), media experts (83.47%), design experts (95%), student responses to individual trials (92.66%), small group trials (95.8%), and field trials (98.75%), which as a whole stated that the Canva application-based mathematics learning media was in the "very good" category".

2. The effectiveness of the developed Canva application-based mathematics learning media is considered more effective than conventional learning media. The results of testing the hypothesis prove that there is a significant difference between the learning outcomes of students who are taught using the Canva application-based learning media and the learning outcomes of students who are taught using conventional learning media. This is indicated by the results of data processing, tcount = 1.98 and ttable = 1.66, so that tcount > ttable at a significant level $\alpha = 0.05$. So the learning outcomes of students who are taught with learning media based on the Canva application have an effectiveness of 84.37% higher than learning outcomes using conventional learning media with an effectiveness of 65.62%.

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ICARE-Based Interactive Learning Media: Improving Digestive System Biology Learning Outcomes for Junior High School Students

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Abstract: This study aims to develop ICARE-based interactive learning media with the digestive system in humans as media content, which is used as a learning medium in the classroom as well as for students' independent learning, especially in class VIII SMP Muhammadiyah 16 Lubuk Pakam. The development of interactive learning media based on ICARE was obtained through observations from educators and students who stated that they needed learning media. Research development using the 4D method by Thiagarajan Has defined, designed, developed, and disseminated stages. The development process involves input from material experts, media experts, and instructional experts, as well as an acceptability test from students. The results showed that: (1) ICARE-based interactive learning media obtained a score of 4.42 for material experts, 4.69 for media experts, and 4.69 for instructional experts. In the field trial of interactive learning media, it obtained a mean value of 4.08 (high acceptability). Guidance and information aspects 4.07 (high), media material aspects 4.13 (high), evaluation aspects 4.10 (high), design aspects and media facilities 4.03 (high), and pedagogical aspects 4.09 (high), each of which indicates that the product being developed is very worth it. (2) The results of implementing ICARE-based interactive learning media were tested using the N-Gain Score to see the effectiveness of using media on learning outcomes. Research results show a 0.6 (moderate effectiveness). The conclusions of the ICARE-based interactive learning media research are feasible to use and effectively improve learning outcomes.

Keywords: interactive learning media; icare; biology; digestive system; natural science

1. INTRODUCTION

The learning process can be said to be good if the activity presents learning activities for students. The existence of interaction and connection between educators and students is expected to create a learning process that is optimally in accordance with the learning objectives. Someone is said to learn if there is a positive change both in terms of cognitive, affective, and psychomotor aspects. Efforts to develop the potential of students can be achieved by providing them with the opportunity to connect with components in the learning system. Dick & Carey [1] state that the components of the learning system are students, instructors or educators, teaching materials, and the learning environment, all of which have interactions in order to achieve learning goals.

Interactions in learning activities are further described by Arsyad [2], who views that the interactions that occur during the learning process are influenced by the environment, which includes students, educators, librarians, school principals, learning materials (books, modules, leaflets, magazines, video or audio recordings, and the like), and various learning resources and facilities (overhead projectors, audio and video tape recorders, radio, television, computers, libraries, laboratories, learning resource centers, etc.).

In the biology study results for the odd semester daily exams for the 2021–2022 academic year, the average score was 48.69 from KKM 65. Meanwhile, if you look further at the percentage of students who have completed the KKM, only 8 out of 23 students have passed the KKM, or 34.78%, while in the other

class, VIII, the learning completeness was only 3.2%. According to class VIII biology educators, the learning process is constrained by the available learning media. Biology educators at SMP Muhammadiyah 16 Lubuk Pakam still use books, pictures, and LKPD as teaching aids in their classes. In addition, anatomical models and pictures are an additional source of learning when explaining material about the digestive system. Classical problems such as a lack of interest in student learning and the fact that the available learning media have not been able to attract the focus of student learning are also problems that exist in SMP Muhammadiyah 16 Lubuk Pakam.

Based on the results of research on the use of learning media in Biology lessons conducted by Oktarini, Jamaluddin, and Bachtiar [3], it was stated that the use of instructional media plays a role in helping students understand the material. The animation media used by the team of 12 researchers is claimed to be able to improve student learning outcomes compared to only using picture media in biology lessons.

The ICARE learning model is the cornerstone in developing interactive learning media because this model is from the researcher's point of view and provides learning concepts whose problem solving can be linked to problems related to everyday life, so that it is expected to be relevant to students' initial knowledge. The developed learning media are expected to make it easier for students to understand both concepts and theories, so that students are also more proactive in learning and learning objectives can be achieved by increasing learning outcomes.

1.1 The Nature of Learning Biology

Learning in Sardiman [4] is defined broadly as a psychophysical activity leading to full personal development. Then, in a narrow sense, learning is intended as an effort to master scientific material, which is part of the activity towards the formation of a complete personality. Furthermore, Sukmadinata [5] views learning as always related to changes in the learner, whether they are planned or not. Another thing that is always related to learning is experience, either in the form of interaction with other people or their environment.

Then Rusman [6] has the view that learning is a system. The implementation of learning is an integration of various components that have their own functions, with the intention that learning can run as it should. Reigeluth & Merill [7] classify learning variables into three categories: learning conditions, learning methods, and learning outcomes. Learning conditions are the first point explained by Reigeluth, showing that learning conditions are the beginning of how learning will be presented, starting from the objectives and characteristics of learning materials, constraints, and students. By understanding how the learning conditions are, learning methods and learning outcomes can be formulated. If learning is seen as a process from initial activities to learning outcomes, a learning strategy is needed in which methods, structures, and management are formulated to achieve effective learning outcomes.

Biology is part of the Natural Sciences (IPA), which deals with how to systematically find out about nature so that it is not only the mastery of a collection of knowledge in the form of facts, concepts, or principles but also a process of discovery. Science education is expected to be a vehicle for students to learn about themselves and the environment, as well as prospects for further development in applying it in everyday life. The learning process emphasizes giving direct experience to develop competencies in order to explore and understand the natural surroundings scientifically. Science education is directed toward inquiry and action so that it can help students gain a deeper understanding of the natural world around them.

Anjarsari [8] stated that the government mandated in the 2013 curriculum that SMP Science subjects be developed as integrative science subjects, application-oriented, developing thinking skills, learning abilities, curiosity, and caring attitudes and responsibility for the natural environment. The general learning objectives are to increase knowledge, skills, and attitudes in a balanced way.

The digestive system in humans is one of the subjects studied in class VIII IPA. The digestive system is the body's mechanism that processes food essences in the form of nutrients found in food and drinks consumed by humans. The digestive system in humans starts with the mouth, esophagus, stomach, small intestine, and large intestine. The digestive system in humans also discusses the nutrients the body needs as well as problems (disorders) in the digestive system.

1.2 ICARE Learning Model

The link between learning strategies and learning models Hadratullah [9] explains that learning strategies are activity plans in the form of steps in learning and the use of various facilities and infrastructure to achieve a goal. While the learning model is part of the learning strategy, which is a sequence of activities in classroom learning,

The ICARE learning model was developed based on a simple pedagogical model [10]. The pedagogical model is a way of learning done by looking at the learning process, management, and interactions between educators and students. ICARE includes five key elements of the learning experience that are organized into several sections, namely: Introduction, connection, application, reflection, and extension.

Thus, it can be concluded that the ICARE learning strategy is to maximize student learning activities. The strategy that can be carried out is by planning learning activities in which there are plans of action, activities, utilization of resources, and how to collaborate everything in order to achieve learning goals.

1.3 The Nature of Learning Media

According to Arsyad [11], the media is defined as an intermediary or messenger. Meanwhile, Smaldino [12] states that media is the plural form of intermediary, which is a means of communication. With the media, the flow of information can be disseminated from the sender of the message to the recipient of the message. The use of media in learning is a must, because even with the lecture method, the media used is oral. Like Personal opinion [13], which states that the use of media as a learning tool has been around for a long time, even since humans carried out learning processes and activities.

Furthermore, when paired with learning, learning media is defined by Soenarto et al. [14] as all kinds of tools or equipment in any form that can be used by educators, teachers, instructors, or trainers to help and expedite the learning process.

Learning media, according to Arsyad [15], is a medium that carries a message in the form of information that has instructional purposes and contains teaching intent. Learning media include tools that are used physically to convey teaching material. The media used in learning is intended to make the learning process more effective and efficient.

Wibawanto [16] states that an interactive learning medium is a product of multidisciplinary knowledge, so if the maker of the medium only masters the creation and processing of material, graphics personnel are needed to work on this stage. To produce interactive learning media that are in accordance with procedures but also without forgetting the aesthetic element, educators must be not only proficient in operating applications but also include elements of artistic touch.

Learning media used in learning have a function as a tool for educators in the teaching and learning process. Arsyad [17] argues that one of the main functions of learning media is as a teaching aid, which also influences the climate, conditions, and learning environment that are arranged and created by educators. Smaldino [18] states that technology and media can play many roles in learning. If learning is centered on educators, then technology and media are used to support the presentation of subject matter. However, if learning is student-centered, students will play the role of the main users of the technology and media used.

1.4 ICARE-Based Interactive Learning Media

ICARE-based learning media are learning media developed using the principles of the ICARE learning model. The

developed ICARE-based interactive learning media includes five key elements of the learning experience, namely: Introduction, Connection Application, Reflection, and Extension.

Broadly speaking, learning media development activities consist of three major steps that must be passed, according to Sugiyono [19], who explains that developing learning media requires planning, production, and assessment activities. Furthermore, Reigeluth [20], in a learning paradigm that is centered on student learning activities, states that the main role of using technology in learning is to serve students, whereas with learning media, students play a more central role.

The use of the ICARE learning model in the development of interactive learning media aims to ensure that students have the opportunity to learn with media that are appropriate to the problem and the surrounding environment, as well as to provide

opportunities for students to apply what they have learned. As a learning resource developed to assist educators in learning in the classroom. ICARE-Based Learning Media is also anything that can support the learning process so as to provide positive changes. Learning media used in learning have a function as a tool for educators in the teaching and learning process.

One strategy that can be used by educators in learning science (biology) is an inquiry-based learning strategy. The inquiry-based learning strategy was then carried out based on the ICARE learning model. The ICARE learning model was developed departing from a simple pedagogical model, namely how learning is directed by stimulating students' focus on learning objectives, connecting to problems encountered in everyday life, how to apply them, measuring the achievement of learning objectives, and following up with follow-up activities so that students' learning activities are more optimized.
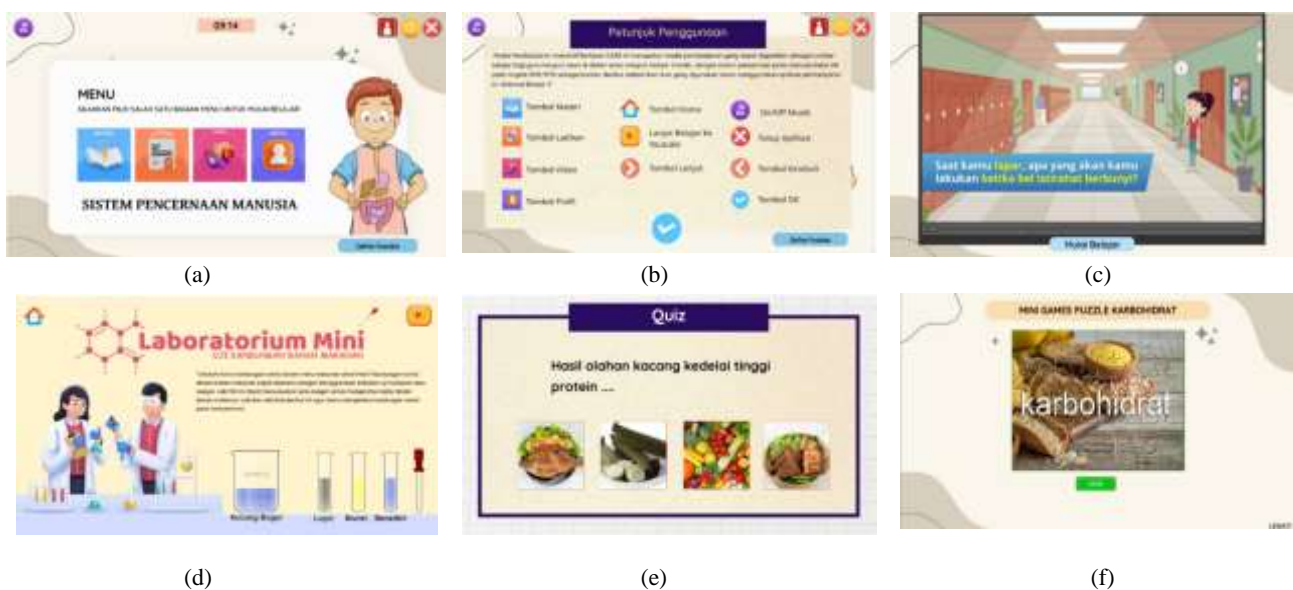

Figure 1. (a) Initial Menu Display; (b) Media Use Instructions; (c) Introduction Videos; (d) Mini Laboratory Display; (e) Display a short quiz; (f) Mini Games

The research problems are formulated as follows: (1) Is it appropriate to use ICARE-based interactive learning media in learning material on the human digestive system?; and (2) Can interactive learning media based on ICARE be effective in increasing learning outcomes in the subject of the human digestive system?

2. METHOD

The research model used is Research and Development or Research and Development (R&D). Sukmadinata [21] stated that the research and development (R&D) method is a strategy or research method that is powerful enough to improve practice.

Research and development of the Research and Development cycle, which consists of studying research findings related to the product to be developed, developing a product based on the findings, testing the product where the product will be used, and finally revising it to correct deficiencies found in the testing phase, The next stage is Research and development; this cycle is repeated until the trial results show that the product fulfills its purpose or is suitable for use.

This research will be carried out at SMP Muhammadiyah 16 Lubuk Pakam, Lubuk Pakam District, Deli Serdang Regency, for class VIII students in the Odd Semester for the 2022/2023 academic year.

The procedure and development design used in this research are research and development. In research and development methods, there are several types of models. The model used in the development of ICARE-based interactive learning media is a 4-D model. The 4-D (Four D) development model is a learning device development model. This model was developed by S. Thiagarajan, Dorothy S. Semmel, and Melvyn I. Semmel [22]. The 4D development model consists of 4 main stages, namely: Define, Design, develop, and Disseminate. This method and model were chosen because they aim to produce products in the form of interactive learning media. The products developed are then tested for feasibility, validity, and product trials to determine the extent to which ICARE-based interactive learning media products are appropriate for use in classroom learning. The research design used in this research is the 4-D model development research design (Four D Models), according to Thiagarajan. This includes four stages, namely the define, design, develop, and disseminate stages.

A feasibility analysis of ICARE-Based Interactive Learning Media was carried out to measure the feasibility of the ICARE-based interactive learning media that was developed. Data analysis was carried out based on expert validation questionnaires consisting of material experts, instructional design experts, media experts, and user (student) acceptability. Questionnaire data processing in this research and development is for calculating media validity with the percentage of answers.

Meanwhile, as a basis for decision-making to revise ICARE-based learning media products, the feasibility level criteria are used as written in Table 1 below:

Table 1. Interpretation of multimedia eligibility

No	Percentage of Achievement	Interpretation
1	1,00 – 2,49	Not Eligible
2	2,50 – 3,32	Less Feasible
3	3,33 – 4,16	Decent
4	4,17 – 5,00	Very Decent

ICARE-based interactive learning media is said to be suitable for use if it reaches a percentage of 75% or even close to 100%, while ICARE-based interactive learning media is said to be inappropriate if it has a percentage below 65%.

An analysis of the effectiveness of ICARE-based interactive learning media was carried out to measure the effectiveness of the developed interactive learning media. Data analysis was carried out based on student learning outcomes tests (pretest and posttest) using the N-gain score.

Data analysis in the form of pretest-posttest learning result data was carried out to find out the increase in learning outcomes, which was carried out using the N-gain score formula as follows (Sundayana, 2016):

$$\text{N} - \text{Gain Score} = \frac{\text{Posttest Score} - \text{Pretest Score}}{\text{Maximum score} - \text{prestest score}}$$

After obtaining the results from the data managed using the formula above, these results are matched with the N-gain score criteria as shown in Table 2 below:

Tabel 2 Criteria for N-Gain Score

No	Criteria	Boundary
1	High	N-Gain score ≥ 0.7
2	Moderate	0.3 ≤ N-Gain score ≤ 0.7
3	Low	N-Gain score ≤ 0.3

(Sumber: Hake [23])

ICARE-based interactive learning media is said to be effective if the minimum N-Gain score is in the moderate category, or in other words, if there is a significant increase in learning outcomes between before and after the use of ICARE-based interactive learning media and the percentage of students who meet the criteria increases after using the media. ICARE-based interactive learning

Whereas ICARE-based interactive learning media is said to be ineffective if the N-Gain value has a low category, or in other words, there is no increase in learning outcomes, and the percentage of students who meet the criteria after using ICARE-based interactive learning media's learning outcomes

do not increase, decrease, or remain the same as before using ICARE-based interactive learning media.

3. RESULTS AND DISCUSSION
3.1 RESULTS
The ICARE-based interactive learning media assessment results were validated for material experts, media experts, individual trials, small group trials, and limited field trials for all aspects of the assessment determined by the average score. The results of the assessment were then analyzed and determined whether or not it was appropriate to develop Scandura structure-based e-learning tools. The average percentage of the results of the assessment of media experts, material experts, individual trials, small group trials, and field trials is shown in Table 3 below:

Table 3. ICARE-based interactive learning media assessment results

No	Categorization	Percentage of average score	Criteria
1.	Material Expert Validation	4,42	very feasible
2.	Media Expert Validation	4,69	very feasible
3.	Learning Design Expert Validation	4,69	very feasible
4.	Individual Trial	4,45	very feasible
5.	Small Group	4,20	very feasible
6.	Field Testing	4,08	very feasible
Rata-rata		4,42	very feasible

Feasibility ICARE-based interactive learning media learning tools show that the results of material expert validation, media expert validation, individual trials, and field trials show an average of 4.42 in the very feasible category, which means that the use of ICARE-based interactive learning media meets the needs of students, is well received by students, and can have a high pedagogical effect.

Measuring effectiveness is done by doing a pretest and a posttest. At the time of conducting the pretest, students were given ICARE-based interactive learning media before being given the posttest, while in the posttest phase, it was carried out after students had received the teaching and learning process using ICARE-based interactive learning media.

After obtaining the values in the pretest and posttest phases, the researcher then needs to calculate the difference between the two. The calculation of the difference in value is intended to show the level of effectiveness of using ICARE-based learning media in classroom learning, especially in science lessons on the digestive system in class VIII.

The N-Gain Score is used to see a comparison between the gain or achievement scores obtained by students and the highest gain or achievement scores that students might get. The scores obtained after the pretest and posttest are as follows:

Table 4. Pretest and Posttest Test Results

No	Prettest	Posttest	N-Gain Score	Criteria
1	47,5	80	0,6	Moderate
2	50	85	0,6	High
3	45	90	0,8	High
4	50	85	0,7	High
5	40	70	0,5	Moderate
6	57,5	87,5	0,7	High
7	62,5	92,5	0,8	High
8	45	85	0,7	High
9	50	75	0,5	Moderate
10	50	77,5	0,6	Moderate
11	25	60	0,5	Moderate
12	50	72,5	0,5	Moderate
13	52.5	72,5	0,4	Moderate
14	40	82,5	0,7	High
15	60	80	0,5	Moderate
16	55	80	0,6	Moderate
17	35	60	0,4	Moderate
18	35	80	0,7	High
19	32,5	72,5	0,6	Moderate
20	52,5	75	0,5	Moderate
21	57,5	85	0,6	Moderate
22	57,5	87,5	0,7	High
Total	1050	173,9	0,6	Moderate
Mean	47,7	78,9	0,6	Moderate
Value Result	"Medium" Category Effectiveness			

A total of nine students demonstrated effectiveness with "high" criteria, while 13 students had "moderate" criteria. Medium and high criteria theoretically mean that there is a significant increase in learning outcomes between pretest and posttest, which can also mean that the use of ICARE-based interactive learning media is effective in increasing students' cognitive or knowledge as assessed by an increase in learning outcomes. The average result is 0.6 in the moderate category. Thus, overall, the results obtained showed that the use of interactive learning media based on ICARE provided a significant increase in learning outcomes for students of SMP Muhammadiyah 16 Lubuk Pakam, class VIII.

3.2 DISCUSSION
Research and development on ICARE-based interactive learning media produces products in the form of learning media that can be used as learning resources for students. ICARE-based interactive learning media can be used as a source of learning in the learning process in class. The ICARE learning model was developed based on a simple pedagogical model [24]. The pedagogical model is a way of learning done by looking at the learning process, management, and interactions between educators and students. ICARE includes five key elements of the learning experience that are organized into several sections, namely: Introduction, connection, application, reflection, and extension. Based on this learning model, interactive learning media are designed and developed following the stages of learning.

The process of developing ICARE-based interactive learning media was developed using the development research method, namely research that aims to produce a particular product. Sukmadinata [25] states that the research and development (R&D) method is a strategy or research method that is powerful enough to improve practice. The product resulting from this research is interactive learning media as an alternative source

of learning. Educators and students are given flexibility in their use of the media as a learning resource or as a teaching aid.

Media as a teaching aid means that educators use interactive learning media based on ICARE, discussion, and direct question and answer in class. Meanwhile, the media as a source of learning for students is given the freedom to study whenever and from anywhere according to the learning time that students have. The development of interactive learning media based on ICARE on the subject of the digestive system in class VIII humans, went through an assessment process by several experts who were competent in their fields. Material about the digestive system in humans becomes content that is contained in the learning media developed to get a value of 4.42 with the criteria of "very feasible".

The use of ICARE-based interactive learning media in class VIII students with the subject of the digestive system in humans shows a positive influence on mastery of concepts and systems, and has a positive effect on learning outcomes. ICARE-based interactive learning media is used as a learning resource by educators in the classroom during science (Biology) lessons as well as a learning resource for students outside the classroom.

Hamalik [26] defines learning outcomes as changes in behavior in a person that can be observed and measured in the form of knowledge, attitudes, and skills. In an effort to improve learning outcomes, students are given a pretest to find out the extent of their understanding. Interactive learning media based on ICARE are then used in the teaching and learning process between educators and students. At this time, the researcher acts as an observer to determine whether the use of media is appropriate or not.

The posttest is given after the entire content or material in the media has been studied. 99 The N-gain (normalized gain) score is used to measure the effectiveness of using a particular approach or method in a study. By applying the pretest and posttest n-gain scores to measure whether there is an increase in knowledge and cognitive learning outcomes between before and after the use of ICARE-based interactive learning media in learning science (Biology).

The results of the n-gain score measurement get a mean score of 0.6 (medium effectiveness), thus the use of ICARE-based learning media is effective in improving learning outcomes. Based on some of the descriptions above, it can be concluded that the developed ICARE-based interactive learning media is suitable for use in the teaching and learning process in the classroom or as an independent learning medium for students, especially in Biology Science lessons on the material of the human digestive system. And in general, it is considered effective in improving student learning outcomes in an effort to achieve learning goals.

4. CONCLUSION
Based on the formulation of the problem, objectives, results, and discussion in the research on the development of ICARE-based interactive learning media on digestive system material in class VIII SMP Muhammadiyah 16 Lubuk Pakam, which has been described previously, several points can be concluded as follows:

1. Products in the form of ICARE-based interactive learning media have very feasible results when used in the learning process in the classroom. This is supported by several

validation processes involving material, media, and instructional experts, all of which are "very feasible" to use.

2. In the effectiveness test using the N-Gain Score, learning using ICARE-based interactive learning media shows an increase in learning outcomes before and after using learning media that was developed with a value of 0.6, or getting into the "moderate" category. Thus, it can be said that ICARE-based interactive learning media are effective for improving science learning for students.

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Games Based on Contextual Teaching and Learning: Improving Science Learning Outcomes for Elementary Students

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Abstract: This study aims to: (1) produce learning media that are suitable for use in learning; (2) find out the practicality of the developed media; and (3) find out the effectiveness of CTL-based game learning media. This type of research is development research using the DDD-E development model, namely decide, design, develop, and evaluate. The game media developed consists of materials, match-up games, and quizzes. This research was conducted on fourth grade students at SD N 8 Kebayakan. The design of this study used a post-test only control design, with a sample of 38 students consisting of 19 students as an experimental class who were taught using CTL-based game learning media and 19 students as a control class who were taught with book media, print, and conventional models. The feasibility test obtained a result of 4.42, which means "Very Feasible" and the practicality test obtained a result of 4.57, which means "very practical". The results of the hypothesis test prove that there is a significant difference between the learning outcomes of students who use CTL-based game learning media and the learning outcomes of students who use textbook media. This is indicated by the acquisition of data, namely, a significance value of 0.000. Value (sig) < 0.05, then Ho is rejected and Ha is accepted. So it can be concluded that CTL-based game learning media can improve student learning outcomes in class IV Science subjects at SD N 8 Kebayakan.

Keywords: game learning media; contextual teaching and learning; science learning outcomes

1. INTRODUCTION

Learning media using computers is developed and packaged in the form of interactive multimedia. There are several forms of learning interaction that can be used in the design of interactive learning media. The form in question starts with (a) drill and practice (drill and practice); (b) tutorials; (c) games (games); (d) simulation; (e) discovery; and (f) problem solving [1]. In the case of this research, media development is designed in the form of a game. Game-application-based learning is now a research trend in education. Based on this research, positive results were found in the development of game-based learning media, and the researcher suggested further research on this game should be continued on other research objects. The role of games can make students concentrate more, practice sportsmanship, and also train them to solve problems because in games there are problems that must be solved quickly and precisely. Games can be a source of learning if they aim to achieve learning goals. With the role of games in the learning process, it certainly reduces the boredom of students towards the conventional teaching and learning process in the classroom. The end of a fun learning process will make students achieve good learning outcomes as well.

Science subjects are subjects that were born with an independent learning curriculum for the elementary school level. Of course, the available learning media are not varied. Natural and Social Sciences (IPAS) is a science that examines living and inanimate things in the universe and their interactions, as well as human life as individuals as well as social beings who interact with their environment. With this, the game development carried out will visualize how interactions that can be carried out in everyday life between humans and nature will be achieved.

In teaching and learning activities, an approach is needed [2]. The teacher must have a good teaching approach and choose the right learning approach in accordance with the concept of the subject to be delivered. The use of learning models in natural sciences subjects must of course be adapted to the characteristics of the subjects themselves. This subject examines nature and social issues; therefore, a suitable learning model is contextual teaching and learning.

At the time of the observation, at this school, the teacher was still using the lecture method, which focused on the teaching and learning process only. With the use of a contextual learning model (Contextual Teaching and Learning, or CTL), which is a holistic educational process that aims to motivate students to understand the meaning of the subject matter they are studying by linking the material to the context of their daily lives (personal, social, and cultural) so that students have knowledge and skills that can be flexibly applied (transferred) from one problem to another [3].

Saragi and Simbolon [4] explained that through a contextual learning approach, learning will be more meaningful because children will "experience" what they are learning, not "know it". Based on teaching and learning activities that emphasize contextual approaches, students will always be invited into the everyday environment because their knowledge is formed through the basic knowledge they already have. This is in line with the opinion of Hobri et al. [5], who state that Contextual Teaching and Learning (CTL) is a learning approach that links the material being studied with real-life situations of students

so that the knowledge gained by students becomes more meaningful and useful for their lives.

1.1 The Nature of Science Learning and Learning Outcomes

Learning is a process of thinking and changing through several stages or repeated exercises to acquire knowledge [6]. According to Maâ [7], learning is not limited to reading, listening, writing, assignments, and tests; there is also a change in behavior from the results of the learning process, where there is interaction with the environment, and these changes are permanent. In addition, Festiawan [8] argues that learning is a process of acquiring knowledge and experience in the form of relatively permanent or permanent changes in behavior and the ability to react due to individual interactions with their environment.

In a book written by Hapudin [9], it is explained that Skinner defines learning as "a process of progressive behavior adaptation". So, learning is a process of adaptation (adjustment) that is progressive. In addition, Robert M. Gagne defines learning as changes that occur in human abilities that occur after continuous learning, not only caused by growth processes. Then Piaget said that learning will be successful if it is adjusted to the stage of cognitive development of the students.

Marwa et al. [10] say that the combination of science and social studies subjects is expected to trigger students ability to manage the natural and social environment in one unit. In line with research conducted by Heny and Aviventi [11], science helps students solve real 21st century problems scientifically related to natural and social phenomena that surround them, using scientific concepts to gain decision-making skills.

The subject of Natural and Social Sciences (IPAS) is a science that studies non-living (abiotic) and living (biotic) things in the universe and their interactions, as well as human life as individuals as well as social beings related to the environment. In addition, Agustina et al. [12] explained the purpose of learning natural sciences in an independent curriculum, namely being able to develop students' curiosity and interest, being able to play an active role, developing inquiry knowledge, mastering oneself and the environment, and developing an understanding of the concepts that exist in learning natural sciences itself.

According to BKSAP [13], the Natural and Social Sciences (IPAS) is a science that examines living and inanimate things in the universe and their interactions, as well as human life as individuals as well as social beings who interact with their environment. Science helps students grow their curiosity about the phenomena that occur around them. The basic principles of scientific methodology in science learning will train scientific attitudes (high curiosity, critical thinking skills, analysis, and the ability to draw the right conclusions), which give birth to wisdom in students. As a country that is rich in culture and local wisdom, it is hoped that through IPAS, students will explore the wealth of local wisdom related to IPAS, including using it to solve problems.

1.2 The Nature of Game Learning Media

Learning media is anything that is used as an intermediary or liaison from the information provider, namely the teacher, to the recipient of the information or students, which aims to stimulate students to be motivated and able to follow the learning process as a whole and meaningfully [14]. According to Kustandi and Darmawan [15], learning media is a tool that can help the teaching and learning process, which functions to clarify the meaning of the message conveyed so that the lesson objectives are better and more perfect.

Educational games are the same as games in general. The difference lies only in the benefits, content, and objectives. The benefits of using educational games include not only providing entertainment for users but also providing knowledge and understanding. The content of the educational game is in the form of learning materials. The goal contained in the education game is to foster students' desire to always learn so that it results in student interactivity, which makes students more relaxed, enthusiastic, and open to receiving learning material [16].

Rokhayani, Kuswandi, and Abidain [17] said that gamification-based interactive multimedia will contain explanations about the material, games that are able to attract students' attention, as well as practice questions. Through interactive multimedia, students will be guided by a computer to carry out several activities, namely watching, reading, and playing. The material will be packaged in communicative language so that this gamification-based interactive multimedia can make it easier for students to learn.

Then Citra [18] said games are all contests that cause interaction with one another between players by following existing rules that have been determined to achieve a goal. One of the interesting and interactive learning media that prioritizes collaboration and communication and can lead to interaction between students is through games, which have the characteristics of creating motivation in learning, namely fantasies, challenges, and curiosity [19].

Fitriati [20] said there are eight models of learning games that can be made, including: Crosswords (crossword), Multiple Choice (multiple choice), Word Search (looking for words among random letters), Noughts and Crosses (choosing the correct answer by up to the transverse position), spell It (giving answers by spelling letter by letter), Anagram (exchanging letters in words so that the word has another meaning), Match-up (matching), and memory (choosing answers according to the order determined). In research, researchers develop games in the form of match-ups.

Akbar and Hadi [21] stated that match-up (adjusting) is a game aimed at matching questions and functions or definitions. In line with what was explained by Andrea and Palupi [22], the match-up type Edugame has game rules, namely that players must match the same object images from the play menu. It was also explained by Fiah and Amaliah [23] that match-up games can train students' memory, cognitive skills, and problem-solving skills. Andrea stated that match-up is a type of game that hones players' memory to match pairs of the same picture. Fitriita [24] also explained match-up, or matching between questions and answers, where the answers are shifted to be attached to the correct question position. From the definition above, it can be concluded that Match-up is a form of game that has a scenario of matching or matching objects, be they pictures, words, or sentences, that are in the right position or menu.

1.3 CTL (Contextual Teaching and Learning) Based Learning Media

According to Sulfemi [25], contextual learning Contextual Teaching And Learning, or CTL, is a learning concept that

helps teachers connect the subject matter they teach with real-world situations of students and encourages making connections between the knowledge they have and its application in their daily lives. Then Alpian et al. [26] found that the learning model of contextual teaching and learning is a learning model that encourages students to take an active part in learning and engages students with real life situations. Thus, the contextual teaching and learning model is a learning concept that encourages students to be active learners by connecting the material being taught with their real-life situations every day.

From the definition above, science lessons are very suitable for using contextual learning models because this subject teaches about natural and social conditions that interact directly with students in their daily lives. CTL stages according to Widyaiswara et al. [27]: (1) At first, it leads to constructivism; (2) The second stage creates inquiry learning; (3) The third stage Directs the submission of questions; (4) Stage four organizes students in groups; (5) Stage five, the teacher presents the model in learning; (6) Stage six, The teacher reflects; and (7) The final stage is that the teacher conducts an authentic assessment.

According to Adawiyah [28], there are several general stages to introducing CTL in the classroom: (1) Growing the idea that children learn more effectively when they work independently, discover who they are, and create their own new knowledge and abilities; (2) completing as many question-based tasks as positive results.

possible for all themes; (3) Encouraging students' natural interest by asking questions; (4) Forming a learning community; (5) displaying each model as a learning example; (6) taking time to think; and (7) carrying out evaluation in various methods.

Then the learning stages with the contextual teaching and learning model using the media game are described as follows: (1) Asking trigger questions; (2) Giving students the opportunity to solve a problem; (3) Asking questions about the topic being discussed; (4) Making discussions with colleagues; (5) Providing game learning media that has been developed; (6) Reflecting using the results of quizzes in the media; and (7) Conducting evaluation

Aslam et al. [29] Mobile learning media based on a contextual approach to understanding mathematical concepts is feasible, practical, and has a positive effect on student learning outcomes.

Ramadhani et al. [30] in their research on contextual-based games showed that acquisitions that met the category were very effective in increasing student learning outcomes in economics subjects. In line with Ilmia, et al. [31] obtained research results showing that the application of contextual-based science board game learning media as a science-edutainment medium influences the understanding of class VIII students at SMP Bustanul Muta'allimin Blitar on material pressure and its application influences learning outcomes, obtaining

Figure 1. Display: (a) initial page view; (b) credit page; (c) presentation of material; (d) instructions for use; (e) material menu; (f) presentation of material; (g) game page; (h) game pages; (i) game page

The research problem is formulated as follows: (1) Is the CTL-based game learning medium in science subjects appropriate to use? (2) Is the CTL-based game learning medium practical for science subjects? (3) Is the CTL-based Game learning media in science subjects effective in increasing student learning outcomes?

2. METHOD

The type of research conducted is the method of R&D (Research and development). The research design used was a post-test only control design with a control group and an experimental group, where the experimental group was the group that was given special treatment (in this study, media games), while

the control group did not get special treatment or not. using game media only using ordinary methods.

This research was conducted at SD N 8 Kebayakan in Central Aceh District. The time for the research to be conducted is in the Even Semester of the 2022–2023 school year. The development of CTL-based game-based learning media requires evaluation. The evaluation was obtained from research subjects consisting of material experts, media experts, instructional design experts, and product user trials, namely class IV students at SD Negeri 8 Kebayakan. Trials were conducted to collect data as a measure of the success of the developed medium. Product trials will generate suggestions, responses, and assessments for revisions to the media after it is used in the trial phase. Revisions were made to improve the product being developed.

The development model used in this study is the DDD-E development model from Ivers and Barron. The background of using the DDDE model is that it is suitable for developing a multimedia product, and games are a form of multimedia product. This model also has systematic stages where each stage must refer to the previous stage, which has been revised so that it can produce a good product as well. The DDD-E research model is carried out sequentially and continuously and is simpler than other development research models. The stages in this development model are systematic and procedural. The following are the stages in the DDD-E development model:

Material eligibility

$$x = \frac{\sum X}{n}$$

Table 1. Interpretation of Material Feasibility

No	Interval Mean Score	Interpretation
1.	1,00 – 2,49	Not Eligible
2.	2,50 – 3,32	Less Feasible
3.	3,33 – 4,16	Decent
4.	4,17 – 5,00	Very Decent

(Sriadhi [32])

Media eligibility

$$x = \frac{\sum X}{n}$$

Table 2. Interpretation of Media Construction Feasibility

No	Interval Mean Skor	Interpretation
1.	1,00 – 2,49	Not Eligible
2.	2,50 – 3,32	Less Feasible
3.	3,33 – 4,16	Decent
4.	4,17 – 5,00	Very Decent

(Sriadhi [33])

Media Acceptance

$$x = \frac{\sum X}{n}$$

Table 3. Interpretation of Media Acceptance

No	Interval Mean Skor	Interpretation
1.	1,00 – 2,49	Low acceptance
2.	2,50 – 3,32	Acceptance is sufficient
3.	3,33 – 4,16	High acceptance
4.	4,17 – 5,00	Acceptance is very high

(Sriadhi [34])

Practicality Test Data Analysis Techniques. Data analysis in testing the practicality of CTL-based game learning media products in class IV science subjects, namely:

$$x = \frac{\sum X}{n}$$

Table 4. Media Practicality

No	Interval Mean Skor	Interpretation
1.	1,00 – 2,49	Impractical
2.	2,50 – 3,32	Less practical
3.	3,33 – 4,16	Practical
4.	4,17 – 5,00	Very practical

Prerequisite test. a test conducted with the aim of assessing the distribution of data in a group of data or variables, whether the distribution of the data is normally distributed or not. Homogeneity test, namely, a statistical test procedure that aims to show that two or more groups of data samples are taken from populations that have the same variance

Hypothesis testing. Testing a statement using statistical methods so that the test results can be declared statistically significant. The hypothesis of the effectiveness test to be tested is:
$$H_0: \mu_1 = \mu_2$$
$$H_a: \mu_1 \neq \mu_2$$
Keterangan:
μ_1 : Average learning outcomes of students using developed CTL-based Game learning media
μ_2 : Average learning outcomes of students without using the developed CTL-based Game learning media
H_0 : there is no difference in the learning outcomes of students using the developed CTL-based Game learning media
H_a : there are differences in the learning outcomes of students using the developed CTL-based Game learning media
To test the hypothesis, the formula is used::

$$t_{hitung} = \frac{\overline{x}_1 - \overline{x}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

Information
$\overline{x}_1$: average score of sample 1
$\overline{x}_2$: average score of sample 2
S_1^2 : variance of sample 1
S_2^2 : variance of sample 2

3. RESULTS AND DISCUSSION
3.1 RESULTS
The results of the assessment by media experts, material experts, individual trials, small group trials, and limited field trials for all aspects of the assessment are determined by the average score. The results of the assessment are then analyzed and determined to determine whether or not it is appropriate to develop CTL-based game-based learning media. The average percentage of the results of the assessment of media experts, material experts, individual trials, small group trials, and field trials is shown in Table 5 below:

Table 5. Feasibility of CTL-based game learning media for science subjects

No	Categorization	Average score	Criteria
1.	Material Expert Validation	4,26	very feasible
2.	Media Expert Validation	4,41	very feasible
3.	Learning Design Validation	4,55	very feasible

No	Categorization	Average score	Criteria
4.	Individual Trial	4,26	very feasible
5.	Small Group Trial	4,47	very feasible
6.	Field Trials	4,55	very feasible
	Average	4,42	very feasible

Based on Table 3 above, it can be concluded that CTL-based game learning media for science subject matter is very feasible; thus, it is known that the average rating (μo) from experts and trials on students is 4.42, while the criterion threshold value of feasibility (μ) is 70%, then $\mu o > \mu$. So it can be concluded that the CTL-based game learning media in this study are said to be very feasible to use and can meet the needs of implementing science learning.

The product practicality test results are carried out to obtain user opinions regarding the practicality of the media that has been developed. The results of the practicality test are presented in Table 6 below:

Table 6. Practicality Test Results

Media Aspect	Ease of Use	Useful ness	Presen tation	Infor mation
Total Perspect	84,33	87,33	88,6	86,76
Perspect Mean	4,44	4,60	4,66	4,57
Peraspect Assessment Results	Very Practical	Very Practical	Very Practical	Very Practical

From the table above, we can describe that the results from the aspect of ease of use are 4.44, which means they meet very practical criteria, on the usability aspect, 4.60, which means they meet very practical criteria; and on the presentation aspect, 4.66, which means they meet very practical criteria. Meanwhile, the average of all aspects that were tested for practicality was an average of 4.57, which means "Very Practical".

Learning is done using game learning media based on contextual teaching and learning, resulting in the lowest score of 96, the highest of 56, the average value (mean) of 80, the mode of 80, the median of 80, and the standard deviation of 10. The following table shows the frequency distribution and histogram of the post-test of students in the experimental class.

Table 7. Frequency Distribution of Experimental Class Post-test Learning Outcomes

No	Interval	Frekuensi Absolut	Frekuensi Kumulatif
1	56 - 64	2	11%
2	65 - 72	3	16%
3	73 - 80	6	32%
4	81 - 88	5	26%
5	89 - 96	3	16%
	Total	19	100%

Learning done using the conventional method resulted in the lowest score of 28, the highest of 76, a mean (mean) of 52.42, a mode of 52, a median of 52, and a standard deviation of 12.3.

The following is the distribution of frequencies and histograms from the post-test results of students in the control class.

Table 8. Frequency Distribution of Control Class Post-test Learning Outcomes

No	Interval	Frekuensi Absolut	Frekuensi Relatif
1	28 - 37	2	11%
2	38 - 47	3	16%
3	48 - 57	9	47%
4	58 - 67	2	11%
5	68 - 77	3	16%
	Total	19	100%

The normality test is carried out to ascertain whether the samples taken from the population are normally distributed. After analyzing the data using the Lilliefors test. Normal data if the p-value (sig.) is > 0.05. Because the p-value is > 0.05, the data in the control and experimental classes are normally distributed. The results of the data normality test are presented as follows:

Table 9. Data Normality Test

		Shapiro-Wilk		
	class	Statistic	df	Sig.
learning outcomes	control class	0,957	19	0,509
	experimental class	0,943	19	0,296
a. Lilliefors Significance Correction				

Homogeneity Test
A homogeneity test is carried out to determine whether the research data is homogeneous. Homogeneous data if the p-value (sig.) > 0.05. Because the p-value is > 0.05, the variance of the control and experimental class data groups is the same (homogeneous).

Table 10. Homogeneity Test

		Levene Statistic	df1	df2	Sig.
learning outcomes	Based on Mean	0,56	1	36	0,45
	Based on Median	0,45	1	36	0,50
	Based on Median and with adjusted df	0,45	1	34,66	0,50
	Based on trimmed mean	0,53	1	36	0,46

After carrying out the prerequisite tests, namely the normality and homogeneity tests, a hypothesis test was carried out. Because it meets the assumptions of normality and homogeneity, it can be tested for differences with parametric statistics using the t-test. The results of the t-test from the average comparison of the experimental class and the control class Because the p-value (sig.) is 0.05, Ho is rejected and Ha is accepted, meaning that there is a significant difference in the learning outcomes of students in the control class and the experimental class. The learning outcomes of students who were taught using game media were significantly different from

the learning outcomes of students who were not taught using game media. If you look at the average, the average value of student learning outcomes in the experimental class is better than that of students in the control class. The following table results from the hypothesis testing carried out:

Table 11. Effectiveness Test

		t-test for Equality of Means				
		Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
					Lower	Upper
learning outcomes	Equal variances assumed	0,00	-27,57	3,65	-34,99	-20,16
	Equal variances not assumed	0,00	-27,57	3,65	-35,00	-20,15

3.2 DISCUSSION

The media that has been developed has been prepared by considering material factors, instructional design, and media construction experts to produce the final product of game-based learning media based on contextual teaching and learning in class IV science subjects at the elementary school level. This research and development aims to create a media-based learning paradigm that can improve teaching standards and learning outcomes for fourth graders in SD N 8 Kebayakan in science subjects.

The initial steps taken when starting the research were needs analysis, followed by setting learning objectives, determining the theme or scope of the material, developing prerequisite skills, and assessing the availability of resources. After determining that the appropriate medium is a game, the design is carried out in the form of an outline, a flowchart, and a storyboard, which are the basis for developing a product. At the development stage, media components consisting of text, images, games, and audio are aligned so that they are mutually sustainable. Finally, evaluation is carried out by validating material experts, media construction experts, and instructional design experts, and to see the user, individual trials, small group trials, and field trials are carried out in order to create products that are feasible and useful in the learning process and can achieve learning objectives.

The concept is clear, simple, and methodical when the learning process uses game-based learning media based on contextual teaching and learning to make the learning atmosphere in the classroom fun, lively, and independent, as well as provide opportunities to interact with other students, teachers, and the media. Based on the justification given, it can be concluded that game learning media based on contextual teaching and learning have passed evaluations by material experts, media construction experts, instructional design experts, individual trials, small group trials, and field trials with the result "VERY DESERVE" with reference to the media eligibility criteria that have been determined. Supported by research conducted by

Pebriani [35], media is said to be feasible if it meets valid criteria with indicators of language, visual appearance, software engineering, and information about the media. correctness of the concept, systematics and clarity of the concept, implementation, evaluation, and learning strategy. Learning motivation, program design, ease of use, and benefits Another study, namely Sari and Manuaba [36], stated that appropriate media must meet valid criteria in aspects of curriculum, materials, grammar, objectives, strategy, evaluation, message design, operations, and motivation. Supported by the above studies, it can be concluded that game-based learning media are suitable for use in the learning process.

Media that is suitable for use in the learning process is subjected to a practicality test to see how practical it is when used in the learning process in class. Based on the practicality test, it can be concluded that the media developed is very practical, which means that the media developed is easy to use in the learning process in the classroom by fulfilling the aspects of ease of use, usefulness, and presentation. The results of this study are in line with the results of research conducted by Firdaus [37], which states that educational game media are practical to use when users feel easy and comfortable in their use. Besides that, according to Maghfiroh et al. [38], Game learning media are said to be practical if they are valid in terms of quality, convenience, attractiveness, and usefulness. From these studies, it is proven that game media is practically used in the learning process.

Based on data processing and research results that have been carried out, the results found are that there are differences in learning outcomes between students who are taught using game-based learning media based on contextual teaching and learning and students who are taught with printed book media and conventional models in the form of lectures from the teacher only. Specifically, the average value of the science of science that is taught using contextual teaching and learning-based game learning media is higher than that using printed media and conventional models. Supported by research conducted by Sari and Manuaba [39] that game media is used effectively in the learning process because student motivation will appear by itself when the learning atmosphere is pleasant. If students are happy, then the learning process will be effective.

In addition to learning outcomes, there are other aspects that can measure the effectiveness of the media, one of which is critical thinking. According to research conducted by Supandi and Senam [40], the use of game media in the classroom during the learning process can improve students' critical thinking skills, which in the end will also lead to increased student learning outcomes. It can be concluded that the use of game-based learning media is effectively used in the learning process to improve student learning outcomes.

4. CONCLUSION

Conclusions that can be drawn from the formulation, objectives, and discussion of research on the development of contextual teaching and learning-based game learning media in class IV Science subjects at SD N 8 Kebayakan, namely:
1. The development of game learning media based on contextual teaching and learning in class IV Science subjects at SD N 8 Kebayakan is very suitable for use in the learning process.
2. The development of game learning media based on contextual teaching and learning in class IV science subjects at

SD N 8 Kebayakan is very practical to use in the learning process.

3. The development of game learning media based on contextual teaching and learning on science subjects in class IV SD N 8 Most can effectively improve student learning outcomes.

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Problem- Based Learning Informatics E-LKPD: Improving Computational Thinking Skills

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Abstract: This research and development aims to produce PBL-based Informatics E-LKPD learning media to improve students' computational thinking skills. This type of research is development research using the 4D development model, namely: (1) define, (2) design, (3) develop, and (4) disseminate. The results of the study show: (1) Material expert validation tests show that the developed medium is very feasible, with an average score of 84%. (2) Instructional Design Expert validation test with very appropriate criteria and an average score of 87% (3) Media Expert validation test in the very proper category with an average score of 83%. (4) Individual trials with very good criteria and an average score of 90% (5) The criterion small group trial was very good, with an average score of 87%. and (6) Field trials with very good criteria and an average score of 89%. The practicality test by the teacher is very good, with an average score of 88%, while the results of the practicality test on students, with an average score of 90%, are in the very good category. The results of the experiment using PBL-based Informatics E-LKPD in the experimental class averaged 86 learning outcomes, while students who were taught without using PBL-based Informatics E-LKPD had an average score of 70. Hypothesis testing using the Independent t-test obtained a sig. (2-tailed) of 0.000, where the result is <0.05, shows a significant difference between classes taught using PBL-based Informatics E-LKPD and classes without using PBL-based Informatics E-LKPD. Therefore, the use of PBL-based informatics and E-LKPD in effective learning to improve students' computational thinking skills.

Keywords: Informatics E-LKPD; Problem-Based Learning; Computational Thinking

1. INTRODUCTION

Faced with Society 5.0, several skills are needed to be mastered, one of which is the ability to think at a higher level to be able to solve problems. One that can support higher-order thinking skills is literacy. Literacy has a crucial role in the process of improving higher-order thinking skills such as analyzing, evaluating, and creating [1]. However, in a study conducted by Science Performance (PISA) 2018, which is a Worldwide Ranking of the average score of math, science, and reading that measures the scientific literacy of 15-year-old children, it was found that Indonesia got a very low score and was far behind other countries. in other Asian countries. Indonesia was ranked 74th out of 79 countries for reading ability, and 73rd and 71st out of 79 countries for assessments of math ability and science ability, respectively. From here, we realize the importance of literacy. Thus, it is very important to continue to make innovations to improve literacy skills. One way to encourage literacy skills is to master Computational Thinking skills [2].

Computational thinking is a way of thinking or a method of thinking similar to the way used by computer scientists to solve problems using concepts from computer science such as algorithms, programming, data processing, and systematic problem solving. According to Wing [3], Computational Thinking is a high-level thinking skill that enables one to solve complex problems effectively by using principles and methods related to computer science. In this concept, the use of technology, data, and algorithms is seen as part of a complex problem's solution.

One of the things that can help increase student motivation is the use of various media in classroom learning [4]. With a variety of media used, it is hoped that it can facilitate differentiated learning so that it is in accordance with the characteristics of students and that it can increase students' interest and motivation in learning. However, in the field, it is found that there are not many innovative learning media for Informatics, especially with the integration of computational thinking, so that learning is still limited to the use of textbooks.

A study conducted in 2022 entitled "Assessing Computational Thinking: A Systematic Review of Empirical Studies" conducted by Tang [5] found that most assessments of computational thinking focused on students' programming or computing skills, so another study was needed that focused on thinking skills. computational solutions to solve everyday problems outside of computer science or programming. Therefore, it is necessary to develop a learning tool that integrates computational thinking on other topics, as was done by Batul [6], who integrated CT in mathematics with the title "Development of SSCS Model Learning Devices with the RME Approach and Its Effect on Computational Thinking Ability". This study found that the learning design developed was able to improve students' computational thinking skills in a valid, effective, and practical manner.

To prepare a medium that can help learning be optimal, the selection of the learning model to be used is carried out. Santayasa [7] conducted a study of innovative learning alternatives that are suitable for use in the 21st century. The results of the study indicated several learning models that could be used, including the PBL model, project based learning, inquiry learning, and collaborative problem-solving tasks. In line with this research, Loyens [8] also expressed a similar opinion.

1.1 The Nature of Learning and Informatics Learning Outcomes

Dimyati and Mudjoyono [9] Explain that learning involves the occurrence of mental changes in students. Explain that learning is a complex activity. The results of learning take the form of capabilities. After learning, people have skills, knowledge, attitudes, and values.

Learning is an activity, both physical and psychological, that produces new changes in behavior in individuals who learn in the form of relatively constant abilities that are not caused by maturity or something temporary [10].

Suyono and Hariyanto [11] stated in their book that according to constructivism theory, knowledge cannot simply be transferred from the teacher's mind to the student's mind. That is, students must actively build their own knowledge structure through independent exercises.

In connectivism theory, the starting point for learning occurs when knowledge is activated through the process of connecting learners and providing information to a learning community [12]. Connectivism theory states that knowledge is distributed over networks, and therefore learning consists of the ability to construct and traverse these networks [13].

Learning is an indispensable skill that can be strengthened by intellectual activity and mental training. Intellectual activities involve creativity, exploration, innovation, formulating questions, answering questions, solving problems, and thinking critically. Mental training involves developing curiosity, interest, patience, perseverance, practice, competitive spirit, self-motivation, determination, and self-confidence [14].

Sudjana [15] said that the skills students acquire follow the learning experiences they have had. Learning outcomes are the consequences that are obtained after a person performs teaching and learning actions [16].

According to Gani and Zulhaji [17], learning outcomes are changes in behavior, which can be identified by comparing behavior before a person experiences a learning situation with the behavior shown after the learning process occurs. These changes take the form of increased capabilities or abilities in some types of performance or changes in the attitudes, interests, and values of someone who has learned.

According to Nugraha [18], learning outcomes are abilities that children acquire after going through a process of learning activities by themselves. Student learning outcomes are divided into 3 domains, namely the cognitive, affective, and psychomotor domains. According to Bloom in Fauzi [19], there are 3 domains of learning outcomes, namely: (1) The cognitive domain, which is related to intellectual learning outcomes consisting of knowledge, memory, understanding, analysis, application, and evaluation; These six goals are hierarchical in nature, meaning that the ability to evaluate has not been achieved if the previous abilities have not been fulfilled or mastered; (2) The affective domain, with regard to attitudes that consist of acceptance, response, evaluation, organization, and the formation of lifestyles; and (3) the psychomotor domain, with regard to the results of learning skills and the ability to act.

1.2 The Nature of Computational Thinking

Wing [20] defines computational thinking as "solving problems, designing systems, and understanding human behavior by drawing on the basic concepts of computer science." Computational thinking is a way of thinking to solve problems by formulating them in the form of computational problems and compiling solutions to these problems in the form of algorithms [21]. Mushtofa [22] explained that the main activity in computational thinking is problem solving, to find efficient, effective, and optimal solutions that can be run by humans or machines.

There are four foundations of computational thinking known in Informatics, namely Abstraction, Algorithms, Decomposition, and Patterns, which are very basic and are broadly explained as follows [23]: (1) Abstraction, which is extracting important parts of a problem and ignoring the unimportant so that it is easier to focus on solutions; (2) Algorithms, namely writing automated solutions through algorithmic thinking (sequential steps) to achieve a goal (solution). If these sequential steps are given to the computer in a language understood by the computer, you will be able to "instruct" the computer to do the steps. (3) Decomposition and formulation: the problem is such that it can be solved quickly, efficiently, and optimally by using a computer as a tool. Problems that are difficult, let alone big ones, will become easy if they are solved systematically in parts; and (4) Recognizing problem patterns, generalizing, and transferring the problem solving process to other similar problems.

1.3 The Nature of Learning Media

Gerlach and Ely [24] argue that broadly, media are human, material, or events that build conditions that make students acquire knowledge, skills, and attitudes. AECT (Association for Educational Communication and Technology) defines media as all forms and channels used in the process of conveying information. Miarso [25] argues that media is anything that can stimulate students' thoughts, feelings, attention, and willingness so that it can encourage the learning process in students.

Educational media is anything that can be used to channel messages from the sender to the recipient so that it can stimulate the thoughts, feelings, concerns, interests, and attention of students in such a way that the learning process occurs [26]. Learning Media is anything that can be used to mediate messages to recipients so that they can stimulate the ideas, sympathies, feelings, and interests of students to be involved in learning activities [27].

In this study, the type of media to be used is interactive multimedia in the form of Student Worksheets (LKPD). LKPD is a student guide that is used to carry out investigative or problem-solving activities. One way of implementing it in class is to package the subject matter in the form of LKPD, which has the characteristic of first presenting a phenomenon that is concrete, simple, and related to the concept to be studied [28].

Trianto [29] argues that Student Activity Sheets (LAS) and worksheets (LKPD) can be in the form of guidelines for cognitive development exercises as well as guidelines for the development of all aspects of learning in the form of experimental or demonstration guides.
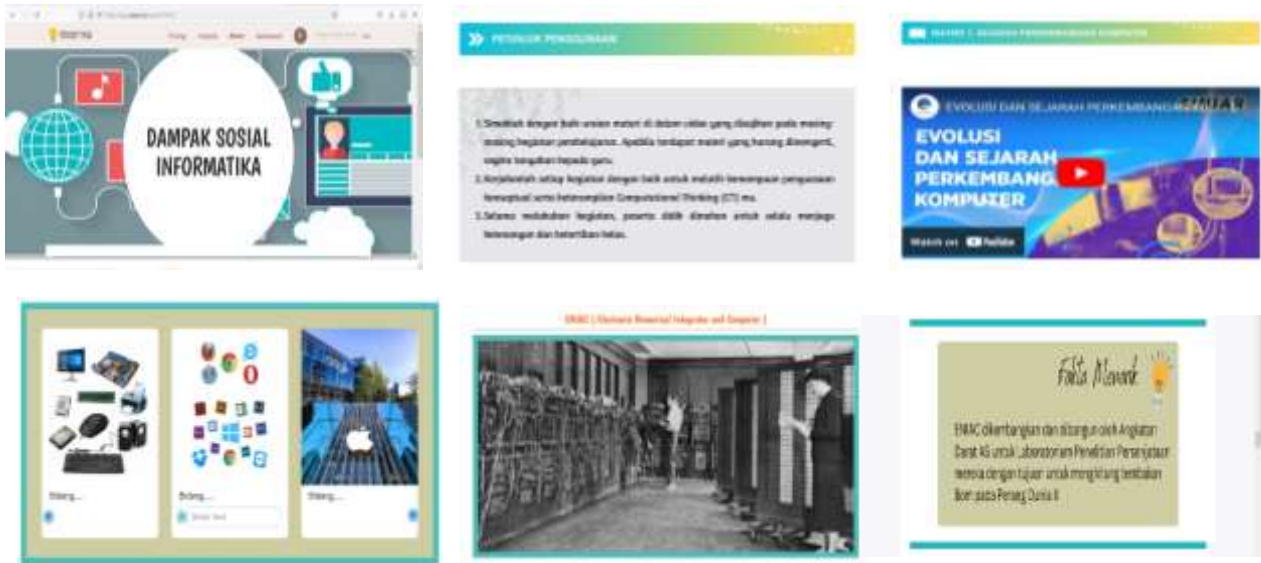
Figure 1. Display of PBL-based Informatics E-LKPD

1.4 Models of Problem-Based Learning

Barret and Moore [30] in their book state that "problem-based learning is the learning that results from the process of working towards the understanding of a resolution of the problem. The problem is encountered first in the learning process." Problem-based learning is learning that results from the process of working towards solving problems. Problems encountered in the learning process.

Problem-based learning is designed by presenting problems and then gaining important knowledge from the problems raised [31]. The characteristics of problem-based learning are that it is more challenging to "learn how to learn", working in groups to find solutions to real-world problems. This given problem is used to tie curiosity to the intended learning. Problems are given to students before they learn concepts or material related to problems that must be solved together.

Arends [32] states that the essence of PBL is to present authentic and meaningful problematic situations to students, which can serve as springboards for investigations. PBL is designed to help students develop thinking and problem-solving skills, learn adult roles, and become independent learners. This model provides an alternative for teachers to present more foamy learning to students. The following are the steps of the PBL learning model:

Tabel 1. PBL Model Syntax

Phase	Teacher Activity
Phase 1	Orienting students to problems, explaining learning objectives and logistics needed, and motivating students to be actively involved in problem-solving activities
Phase 2	Organizing Learners to learn Forming Learners limits and organizes learning tasks related to the problem at hand.
Phase 3	Guide individual or group investigations. Encouraging students to collect appropriate information, carry out experiments, and seek explanations for solutions

Phase	Teacher Activity
Phase 4	Develop and present the work. Help students plan and prepare appropriate works, such as reports, and help students share assignments with friends.
Phase 5	Analyze and evaluate the problem solving process. Helping students reflect on education and the processes used during problem solving

1.5 The Nature of Problem-Based Learning-based E-LKPD

E-LKPD is an electronic form of LKPD that contains practice sheets for students that can be accessed digitally and done continuously and systematically within a certain period of time [33][34]. E-LKPD is designed to guide students in understanding subject matter independently. E-LKPD can be developed using various learning methods, one of which is problem-based learning.

According to Prastowo [35], there are five forms of LKPD, including (1) LKPD that helps students find a concept; (2) LKPD that helps students apply and integrate various concepts that have been found; (3) LKPD as a study guide; (4) LKPD as reinforcement; and (5) LKPD as practical instructions. In this study, the form of PBL-based Informatics E-LKPD that will be developed is a combination of LKPD as a study guide, LKPD as reinforcement, and LKPD that helps students apply and integrate various concepts that have been found. In his book, LKPD consists of six main elements, which include: titles, study instructions, basic competencies or subject matter, supporting information, tasks or work steps, and assessment. In this research, LKPD will be developed based on the PBL model, which is integrated with computational thinking techniques. The following is the E-LKPD design that will be developed:

Table 2. Problem-Based Learning E-LKPD

No.	Media E-LKPD	PBL phase
1	Cover and Title	
2	Instructions for study and use	Phase 1: Orientation of students to problems, explaining the

No.	Media E-LKPD	PBL phase
3	Question lighter	necessary logistics, motivating students
4	Main material in video form	Phase 2: Organizing students to learn
5	Multiple choice questions, matching, fill in the blank	
6	Illustrations pictures and interesting facts	
7	Problem Solving Problems (Included with instructions for solving problems using computational thinking techniques)	Phase 3: Guiding individual or group investigations. In this phase computational thinking techniques will be integrated to help solve problems. Phase 4: Develop and present the work. Help students prepare appropriate results and put them in the results report including helping students share assignments with their friends
8	Reflection	Phase 5: analyzing and evaluating the problem-solving process, students are asked to provide feedback about the learning that has been passed

The research problem is formulated as follows: (1) Is the developed PBL-based Informatics E-LKPD learning media suitable for use in improving computational thinking skills? (2) Is the developed PBL-based Informatics E-LKPD learning media practically used in improving computational thinking skills? (3) Can the developed PBL-based Informatics E-LKPD learning media effectively improve computational thinking skills?

2. METHOD

The research method used is the research and development method (R&D). Gall and Borg [36] in a book entitled "Educational Research" say that R&D in education is an industry-based development model, where research findings are used to design learning products, which are then tested systematically in the field, evaluated, and perfected until a learning product is produced that meets effective, efficient, and quality standards. The development model that will be carried out in this study is the 4D model (define, design, develop, and disseminate) [37].

This research was conducted at SMAN 1 Silaut, which is in Pesisir Selatan Regency, West Sumatra, during the even semester of the 2022–2023 school year. This stage involves testing the product in the field. Evaluation of the feasibility and effectiveness of the product being developed was carried out in class X of SMAN 1 Silaut. The feasibility trial evaluation was carried out in several stages. The first stage is an individual trial, in which there are three student respondents who will be involved. The second stage involved small group trials involving nine students. And the last stage in the feasibility evaluation is a field trial involving 30 students. The product developed will be validated by three experts, including material experts, media experts, and learning design experts, on the feasibility of PBL-based E-LKPD products.

Computational thinking assessments will be assessed by an assessment team consisting of two teachers who will review students' posttest answers. The following is the assessment rubric:

Table 3. Computational thinking assessment rubric

Aspect	Indicator
Decomposition	Students are able to break down problems into smaller problems that are easier to solve
Algoritma	Students are able to make a set of sequences of problem solving steps
	Students are able to solve similar problems using the same steps or principles
Pattern recognition	Students are able to transfer their knowledge and skills to solve problems
	Students are able to identify patterns, similarities, and relationships between the knowledge they have and the problems they face
	Students are able to make conclusions
Abstraction	Students are able to evaluate or distinguish which information is important and which is not important
	Students are able to delete information that is not needed
	Students are able to add or subtract details to clarify problems

Brennan and Resnick [38] dan Csizmadia et al [39]

Feasibility Test Data Analysis Techniques. The data collected from the results of expert validation, then analyzed with the following steps:
  a. Make a tabulation of the answer scores of each instrument item in each aspect..
  b. ind the average score of answers on each aspect with the formula:

$$x = \frac{\sum X}{n}$$

Information:
x: Average score
$\sum X$: The sum of the scores of the statement items
n: Number of data (number of statement items)

To assess the feasibility of the media as a whole, this is done by involving all item scores on the three assessment aspects and calculating the average value with the formula:

$$X_t = \frac{\sum X_i}{N}$$

Information:
X_t: Average score
$\sum X_i$: Total score of the three assessment aspects
N: Total data for the three assessment aspects
To determine feasibility, the results obtained from this calculation are interpreted as in the table below:

Table 4. Percentage of Product Quality Assessment

Percentage %	Validity Level	Information
80 – 100	Very valid	Not Revised
60 – 79	Valid	Not Revised
40 – 59	Invalid	Partial Revision
20 – 39	Invalid	Revision
00 – 19	Very invalid	Revision

(Source: Arikunto[40])

Effectiveness of Test Data Analysis Techniques Data collection techniques were used using the posttest in the control class, and experiments were carried out to determine the effectiveness of teaching modules and PBL-based E-LKPD with test results on the material social impact of informatics on students. Furthermore, the data generated from the test will be tested for its effectiveness. Before carrying out the effectiveness test with the t-test, there are several stages of statistical tests that must be carried out, including the normality test and homogeneity test. The normality test functions to determine whether the distribution of respondent data is normally distributed or not. A homogeneity test is a test of whether or not the variances of two or more distributions are the same.

Hypothesis test. The research hypothesis needs to be tested for validity; in this study, the statistical technique used to test the hypothesis is the t-test (an independent test). The requirements that must be met in the t-test data analysis are the presence of posttest results in the sample group. The hypothesis of the effectiveness test to be tested is as follows:

Ho: $\mu_1 = \mu_2$
Ha: $\mu_1 > \mu_2$

Information::
μ_1: average student learning outcomes using PBL-based E-LKPD to improve computational thinking skills
μ_2: average student learning outcomes without using PBL-based E-LKPD to improve computational thinking skills

Ho: The developed PBL-based E-LKPD is not used effectively to improve students' computational thinking skills.
Ha: The developed PBL-based E-LKPD is effectively used to improve students' computational thinking skills

For hypothesis testing, the two-party test formula is used:

$$t_{hitung} = \frac{\overline{x}_1 - \overline{x}_2}{S\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

Where S is the root of the combined variance calculated by the formula:

$$S^2 = \frac{(n_1-1)S_1{}^2 + (n_2-1)S_2{}^2}{n_1 + n_2 - 2} \text{ dimana } S = \sqrt{s^2}$$

Keterangan:
$\overline{x}_1$: the average score of the experimental class
$\overline{x}_2$: average score of the control class
n_1 : number of experimental class samples
n_2 number of control class samples
$S_1{}^2$: variance in the experimental class
$S_2{}^2$: variance in the control class
S : combined variance
t : calculation price with db = n1 + n2 – 2

The correlation criterion obtained is said to be significant (the hypothesis is accepted) if the price tcount > ttable for a significance level of 5%.

3. RESULTS AND DISCUSSION
3.1 RESULTS
The results of the assessment by media experts, material experts, individual trials, small group trials and limited field

trials for all aspects of the assessment are determined by the average score. The results of the assessment were then analyzed and determined whether or not it was appropriate to develop PBL-based Informatics E-LKPD learning media. The average percentage of the results of the assessment of media experts, material experts, individual trials, small group trials and field trials is shown in table 5 below:

Table 5. Feasibility of PBL-based Informatics E-LKPD learning media

No	Categorization	Percentage of average score %	Criteria
1.	Material Expert Validation	84,00	very feasible
2.	Media Expert Validation	83,00	very feasible
3.	Learning Design Validation	87,00	very feasible
4.	Individual Trial	90,00	very feasible
5.	Small Group Trial	87,00	very feasible
6.	Field Test	89,00	very feasible
The average		86,67	very feasible

Based on the results of the expert assessment and trials in the table above, it was found that the PBL-based Informatics E-LKPD got an average score of 86.67% which is in the "Very good" category, so it can be concluded that the PBL-based Informatics E-LKPD developed is Worthy.

Product Practicality Test on Teachers. The following is descriptive data on the practicality test of PBL-based Informatics E-LKPD learning media by students.

Table 6. The average percentage of PBL-based Informatics E-LKPD media practicality test results for teachers

No	Assessment Indicator	Average Percentage	Criteria
1	Accessibility Aspect	90%	Very good
2	Aspects of Usefulness	88%	Very good
3	Presentation Aspects	87%	Very good
Average		88%	Very good

Product Practicality Test on Students. The following is descriptive data on the practicality test of PBL-based Informatics E-LKPD learning media by students.

Table 7. The average percentage of PBL-based Informatics E-LKPD media practicality test results for students

No	Assessment Indicator	Average Percentage	Criteria
1	Accessibility Aspect	90%	Very good
2	Aspects of Usefulness	90%	Very good
3	Presentation Aspects	90%	Very good
Average		90%	Very good

Product Effectiveness Test Research Data Description. Students' computational thinking skills. The following is descriptive data on students' computational thinking assessment scores in the control and experimental classes:

Table 8. Average score of computational thinking skills in the Control and Experiment Classes

Aspect	Control Class	Experiment Class
Decomposition	3.57	4.43
Pattern Recognition	3.59	4.44
Abstraction	3.47	4.33
Algorithm	3.43	4.10

The results of the study in the experimental class obtained the lowest student score of 64 and the highest score of 100. Meanwhile, the mean value was 86 with a mode of 100 and a standard deviation of 9.606. The following is descriptive data for classes taught using PBL-based Informatics E-LKPD, or what is called the Experiment class.

Table 8. Frequency Distribution of Posttest Learning Outcomes of students who are taught using PBL-based Informatics E-LKPD

Class	Class Intervals	Absolute Frequency	Relative Frequency
1	64 – 69	2	7%
2	70 – 75	3	10%
3	76 – 81	4	13%
4	82 – 88	9	30%
5	89 – 94	6	20%
6	95 – 100	6	20%
Total		30	100%

The results of the study in the control class obtained the lowest student score of 50 and the highest score of 86. Meanwhile, the mean value was 70 with a mode of 60 and a standard deviation of 9.018. The following is descriptive data for classes that are taught using textbooks, which are called Control classes. The results of the data on student learning outcomes in the control class will later be compared with the data on student learning outcomes from the experimental class.

Table 9. Frequency Distribution of Posttest Learning Outcomes of students who are taught not using PBL-based Informatics E-LKPD

Class	Class Intervals	Absolute Frequency	Relative Frequency
1	50 – 55	2	7%
2	56 – 61	3	10%
3	62 – 67	6	20%
4	68 – 73	8	27%
5	74 – 79	6	20%
6	80 – 86	5	17%
Total		30	100%

Before conducting the t-test to assess effectiveness, there are several requirements that must be carried out first, namely the normality test and homogeneity test. The normality test is used to evaluate the distribution of the data used in the analysis. This table provides information about significance, which is a measure of the level of confidence in determining whether the data is normally distributed or not. The following are the results of the research data normality test:

Table 10. Normality Test

Tests of Normality		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	GROUP	Statistic	Df	Sig.	Statistic	df	Sig.
Learning outcomes	Control Class	0.091	30	0.200*	0.979	30	0.785
	Experiment Class	0.118	30	0.200*	0.953	30	0.203
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

To find out whether the data is normally distributed or not, it is done by comparing the resulting significance values. If the significance value is < 0.05, it is concluded that the data is not normally distributed, whereas if the significance value is >0.05, it is concluded that the data is normally distributed.

Based on the results of the normality test performed, a significance of 0.200 was obtained. Based on the criteria used, if the significance is greater than 0.5, then the data can be considered normally distributed. Therefore, it can be concluded that the data used in this study tends to be normally distributed.

The homogeneity test is used to evaluate whether the variance (variation) between several groups or treatments is the same or homogeneous. Homogeneity tests provide important information in evaluating the homogeneity of the variance between the groups being compared.

The basis for decision-making on the homogeneity test is that if the significance value is > 0.05, then the data distribution is homogeneous. However, if the significance value is <0.05, then the data distribution is not homogeneous. The following are the results of the research data homogeneity test:

Table 11. Homogeneity Test

Test of Homogeneity of Variances		Levene Statistic	df1	df2	Sig.
Learning outcomes	Based on Mean	0.028	1	58	0.868
	Based on Median	0.040	1	58	0.842
	Based on Median and with adjusted df	0.040	1	57.706	0.842
	Based on trimmed mean	0.031	1	58	0.860

From the table of homogeneity test results above, a significance of 0.868 is obtained. So, based on the criteria used, if the significance is greater than 0.5, then the data can be considered homogeneous. Therefore, it can be concluded that the data used in this study tends to be homogeneous.

Hypothesis submission. In this study, hypothesis testing was carried out using the Independent t-test, where previously the normality test and homogeneity test had been carried out as prerequisite tests. The t test is a difference test between two unpaired groups, with the aim of knowing whether or not there is an average difference between the two groups. The

independent sample t test is included in parametric statistics, which means that the data normality assumption must be met, or in other words, the data must be normally distributed. The hypothesis in this study is as follows:

Ha: There are significant differences in learning outcomes between classes that study using PBL-based Informatics E-LKPD and classes that are not taught using PBL-based Informatics E-LKPD.

Ho: There is no significant difference between classes taught using PBL-based Informatics E-LKPD and classes taught without PBL-based Informatics E-LKPD.

There are testing criteria for the independent sample t-test, namely, if the sig. (2-tailed) is 0.05, it can be concluded that there is a significant difference. Meanwhile, if the sig. (2-tailed) is > 0.05, it can be concluded that there is no significant difference. The following are the results of the independent t-test on research data:

Table 12. Hypothesis Testing with t-test

Independent Samples Test								
		t-test for Equality of Means						
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
Hasil Belajar	Equal variances assumed	-6.637	58	0.000	-15.96667	2.40568	-20.78217	-11.15117
	Equal variances not assumed	-6.637	57.770	0.000	-15.96667	2.40568	-20.78257	-11.15076

From the calculation results in the table above, it was found that the sig. (2-tailed) is 0.000, where the value is < 0.05, so it can be concluded that there is a significant difference between the experimental class, or the class that is taught using the PBL-based Informatics E-LKPD, and the control class, or the class that is not taught using the E-LKPD PBL-based Informatics.

3.2 DISCUSSION

In this study, an analysis was carried out on the feasibility of PBL-based Informatics E-LKPD learning media. The results of the due diligence by experts showed that this learning medium was declared very good by material experts, with an average percentage of 84%. Instructional design experts also consider this learning medium to be very good, with an average percentage of 87%. Meanwhile, media experts gave a very good assessment, with an average percentage of 83%.

The findings of this study are also in line with other studies that show the feasibility of E-LKPD learning media. Research by Efendi [41] and Zahroh [42] found that the learning media developed were very feasible based on several aspects such as presentation, content, and language.

Theories related to the practicality of learning media support this finding. According to Arikunto [43], practicality is related to the ease of use of evaluation tools, both in preparation, use, interpretation/conclusion of results, and storage. Milala [44] also stated that practicality refers to the ease of using learning media by teachers and students, which makes the learning process meaningful, interesting, fun, and useful, and increases creativity in the learning process.

The findings of this study are also in line with other studies that show the practicality of E-LKPD learning media. Batul's research [45] found that the learning media developed facilitated and helped the implementation of learning. Efendi [46] shows that the use of Student Worksheets (LKPD) makes it easier for students to study independently and carry out written assignments. Zahroh's research [47] shows that e-LKPD based on scientific literacy has a very practical implementation in the learning process.

Based on the results of the research data processing conducted, there are significant differences in Informatics learning outcomes and computational thinking abilities between students who study using PBL-based Informatics E-LKPD and students who are taught using textbooks. Students who study using PBL-based Informatics E-LKPD get an average grade higher than the class that studies using textbooks. This is in line with Nuriansyah's opinion [48] that interactive and innovative learning media can increase students' learning motivation, and this increase in motivation will help improve learning outcomes.

This finding is in accordance with the existing theory that learning media are effectively used to increase the achievement of learning objectives [49]. In addition, interesting multimedia learning media can help increase student interest and motivation, and interesting media can make it easier for students to understand and remember the material presented [50].

This is in line with the results of Malik's research [51], which shows that the use of learning media in the form of interactive multimedia can improve students' computational thinking skills. Efendi [52] and Zahroh [53] showed similar results, showing that the use of E-LKPD in learning can support the learning process, help students understand material more easily, and train students to think critically.

Thus, the results of the study show that the use of PBL-based Informatics E-LKPD in the experimental class significantly improves students' computational thinking skills compared to the control class. This shows that the use of PBL-based E-LKPD Inforamtika learning media in learning is effective in facilitating the development of students' computational thinking and provides significant benefits in the context of informatics learning.

4. CONCLUSION

Based on the formulation, objectives, results, and discussion of PBL-based Informatics E-LKPD media development, it can be concluded as follows:
1. The developed PBL-based Informatics E-LKPD learning media is very suitable for use in improving computational thinking skills
2. The developed PBL-based Informatics E-LKPD learning media is practically used in improving computational thinking skills

3. The developed PBL-based Informatics E-LKPD learning media is effectively used in improving computational thinking skills

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Local Culture-Based Comic Strip: Improving Elementary Students' Social Skills

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Abstract: The aim of the research is to develop comic strips based on local culture that are suitable for use by students; develop local culture-based comic strips that are practically used by students; and develop local culture-based comic strips that are effectively used to improve students' social skills. The 4D development model includes the define, design, develop, and disseminate stages. The research was conducted at SD Negeri Babah Krueng Even Semester for the 2022–2023 academic year in Chapter 6, My Indonesia is Rich in Culture. At the development stage, it consists of validation tests and development tests based on validation assessments from media experts, material experts, and users (teachers). At this stage, trials and dissemination are carried out. The results of the validity test from three experts, namely linguists, presentation experts, and content feasibility experts, obtained results in the "Good" category. The results of the Practicality Test showed that the number of trial scores in percent was 90%. Thus, the results of the pilot study fall into the "very good/very practical" category. The effectiveness test results obtained Gain-Score or increased learning outcomes: seen from the pretest and protest, there is an increase in the classical average score of 0.6; when referring to the gain-score interpretation table, these results indicate an increase that is "Good". The observation results of student activities obtained a preset value of 75%, which is in the range of 61% to 80% with good achievement criteria.

Keywords: comic strips; local culture; social skills

1. INTRODUCTION

The process of children learning to recognize all the behaviors they imitate and beginning to be able to distinguish which behavior is acceptable and has a positive impact and which behavior is unacceptable After they are able to distinguish between what is good and what is not good, children begin to get used to good behaviors and are given reinforcement in accordance with the values and norms that apply [1].

Local culture or local wisdom begins with a community's thoughts, which are considered good thoughts, and then becomes a guideline for people's lives. The grip on local wisdom is based on a sense of tranquility and peace among the people. These local cultural values embody the rules that are currently increasing in society for joint activities. In the procedure for determining local wisdom, rules that direct good community behavior

Picture books make up a larger portion of the media provided in schools. Therefore, it is important to produce comics as outputs from this study, because around 73.3% of students will be enthusiastic about learning if they use colorful comics. Comic media develops in the form of colored comics. This is very relevant to the research conducted by Ririn [2], where teaching media can improve students' learning processes in teaching, which in turn is expected to improve the learning outcomes they achieve. Existing problems can be overcome with learning media, namely with its ability to provide the same stimulation, giving rise to the same perception [3].

The comic strips that have been published in electronic media so far only show a funny storyline, so they are only useful as entertainment. Therefore, the comic strip media that will be made is in the form of a book consisting of fairy tales with an instructional component. Because not all schools have complete facilities such as projectors in the classroom, the comic strips that are being developed are made in book form.

According to relevant research conducted by Indriasih et al. [4], the developed e-comic medium is able to increase students' motivation and interest in learning life skills, help activate students physically and emotionally, and make it easier for students to learn. Hidayah & Ulva [5] Student responses to comic-based learning media in Social Sciences lessons on cooperative material are very feasible for calculating total scores by giving student response questionnaires. Riwanto & Wulandari [6] The use of digital comic media can increase the effectiveness of learning the theme material, which always saves energy, Students become more enthusiastic about learning because, besides reading, they can also see pictures of cartoon characters.

In innovative learning, the teacher must use learning media, because the media is one of the factors that supports the success of the learning process in the classroom. Through media, learning materials will be conveyed easily, and creative use of media can expedite and increase learning efficiency so that learning objectives can be achieved [7]. There are significant differences in learning activities between students who use comic media and students who do not use comic media in the learning process. The activities of students who use comic learning media show better activity than those of students who do not use comic media during the learning process [8]. Based on the results of the research, comics containing simple airplane material can help students absorb the material in depth and completely. This comic is practical and effective for learning [9]

1.1 The Nature of Students' Social Skills

Social skills, or what is further translated into social skills, are the ability to carry out social interactions both verbally and non-verbally and with a positive mindset [10]. Social skills support the success of social relations and enable a person to cooperate with others effectively [11].

According to Riggio [12], social skills are verbal and non-verbal communication skills, including expressivity, sensitivity, and control. Expressivity refers to the skill of communicating or sending messages to others. Sensitivity refers to the skill of receiving and interpreting messages communicated by others. Control refers to skills that are able to regulate and manage communication processes. Social skills enable a person to interact with other people successfully. According to Thompson in Putri et al. [13], social skills are skills for managing thoughts and feelings expressed in an action or deed that does not harm oneself or others.

Based on the description above, the researcher concludes that social skills are the ability to carry out social interactions both verbally and non-verbally, including expressiveness, sensitivity, control, and a positive mindset in interacting with others so that they can be accepted or considered beneficial for themselves, their quality of life, and others.

According to Jarolimek (Bachri [14]), the skills that children need to have are (a) Living and working together, taking turns, respecting the rights of others, being socially sensitive, (b) Learning self-control and self-direction, and (c) sharing ideas and experiences with others. So, these social skills include aspects of life skills to work together: skills to control oneself and others; skills to interact with each other; exchanging thoughts and experiences so as to create a pleasant atmosphere for each member of the group.

Michelson, Sugai, Wood, and Kazdin in Nugraini [15] revealed that social skills are displayed as a means of interacting with other people in the form of skills to interact with each other, exchanging verbal responses, thoughts, and experiences so as to create a pleasant atmosphere for every member of the group. A person with social skills can build competent social relationships with others and perform a strengthening role, standing as a model for those with whom they interact.

Table 1. Dimensions of Social Skills

Dimensions of Social Skills	Skill Indicator
Peer relational skills	1) Learn to say the names of people. 2) Pay attention to the person who is talking.. 3) Use eye contact with others when speaking. 4) Accommodate other people's comments and ideas. 5) Participate appropriately in small talk. 6) Respond with humor.
Self-management skills	1) Using the appropriate loudness and tone of voice.. 2) Express your own feelings when necessary.
Akademic skills	1) Pay close attention to people's understanding. 2) Ask appropriate questions.

Dimensions of Social Skills	Skill Indicator
	3) Keep captions at proper spacing 4) Ask for directions or assistance.
Compliance skills	1) On time. 2) Stay together in your own group. 3) Take care of other people's feelings. 4) Respect the time limit.
Assertion skills	1) Look at someone's understanding. 2) Ask questions 3) Offer to explain or clarify..

The five dimensions that are indicators of social skills mentioned above are interrelated and form a single entity that can provide an overview of an individual's ability to express his feelings both verbally and non-verbally so that they are able to be responded to by others when social interaction occur.

1.2 The Nature of Learning Media

Gagne' and Briggs in Azhar Arsyad (2013: 4) implicitly say that media is a component of learning resources or physical vehicles that contain instructional material in the student's environment that can stimulate students to learn.

The opinion above was added by Sanjaya [17], who stated that media is everything, such as tools, environments, and all forms of activity that are conditioned to increase knowledge, change attitudes, or instill skills in everyone who uses them. In the learning process, the media are needed to channel the information that the teacher wants to convey to students.

The learning media used can be obtained by the teacher by utilizing various existing sources as creatively as possible. Learning media, as a communication intermediary, will play an important role in the learning process. The teacher, as a source of information that will provide knowledge to students as recipients of information, will be helped by the media. The medium used by the teacher to facilitate the process of conveying knowledge can be said to be a learning medium.

Learning media will make the learning atmosphere more enjoyable and add to the learning experience for students. The above statement is reinforced by Sanaky [18], Mursid [19], who state that learning media is an educational tool that can be used as an intermediary in the learning process to enhance effectiveness and efficiency in achieving teaching goals.

Munadi [20], who defines learning media as anything that can convey and channel messages from sources in a planned manner so as to create a conducive learning environment where recipients can carry out the learning process efficiently and effectively.

Media as an educational tool that can create effective and efficient learning can be realized in various forms. Sharon, Deborah, Mims, and Russell [21] categorize media into six categories, namely: (1) text is the most commonly used media, which is alphanumeric characters displayed in any format such as books, posters, blackboards, or computer screens; (2) audio includes anything that can be heard either directly or recorded, such as people's voices, music; (3) visuals used to trigger learning include diagrams, pictures on the blackboard, cartoons, and photos; (4) video is media that displays movement, such as DVDs, video recordings, and animations; (5) the engineer is a three-dimensional medium and can be

touched by students; (6) people can be teachers, students, or subject matter experts.

Sanjaya [22] explained that there are several criteria in the selection of learning media, namely: (1) appropriate and directed to make it easier for students to learn in an effort to understand the subject matter; (2) appropriate and directed to achieve learning objectives; (3) according to the learning material; (4) in accordance with the interests, needs, and conditions of students; (5) paying attention to effectiveness and efficiency; (6) according to the teacher's ability to use it.

1.3 Local Culture-Based Comic Strip

Local culture is a culture that develops in a certain area, is continuously maintained and preserved, and is then recognized by all the people in that area. Aceh is one of the provinces in Indonesia that is very well known as the city of Serambi Mecca. This is because Aceh has Islamic ideological values that are inherent and so strong in the lives of its people.

Comics are considered to make children just happy to see pictures without having to learn to read, resulting in illiteracy. The real criticism is the image elements contained in the comic. The images presented in it contain a lot of hard, rough, and brutal actions taken by comic characters in conveying the story [23]. From a positive perspective, reading comics can help develop a child's imagination. Comics can provide a model that can be used to develop a child's personality [24].

Nurgiyantoro [25], who stated that comics come by displaying pictures in panels (boxes) in a row accompanied by written text balloons and forming a story. The digital comic media used in

science learning using Cartoon Story Maker software on the theme of always saving energy can increase the effectiveness of learning and have a significant effect on the learning process of fourth-grade students [26].

Correct use of language and actual depiction Real dialogue in everyday life makes comic strips attractive to all age groups [27]. Through several panels, the comic strip has been able to briefly represent the overall story. So that the comics in this research are in the form of comic strips, which only consist of four panels or boxes. Each panel contains pictures and the texts of the characters' conversations. The text of the conversation is written in the form of text balloons, which can represent a story as a whole.

Comic strips containing pictures and writing can make students who read them interested. Munadi [28] states that when students pay attention to pictures, they are encouraged to interact with the pictures to make new connections and ideas because pictures can make people capture the information contained in them more clearly than expressed in words.

This comic strip can provide benefits for teachers and students, especially in character education in the form of social care characters and analytical thinking skills. The use of comic strips in education provides an interesting reading experience for students because they present simple cartoon characters [29]. In line with the opinion of Suryatin and Sugiman [30], stating that the use of comics has expanded to become a learning medium, students who use comics during learning gain double benefits, namely feeling satisfied because they have done what they like and can build their knowledge.

Figure 1. Display of scripted comics based on local culture

The research problem is formulated as follows: (1) Are comic strips based on local culture appropriate for use in learning? (2) Are comic strips based on local culture practically used in learning? (3) Are comic strips based on local culture effectively used to improve students' social skills?

2. METHOD
The model used is the development of a 4-D model. The 4-D (Four D) development model is a learning device development model. This model was developed by S. Thiagarajan. The 4D development model consists of 4 main stages, namely: Define, Design, develop, and Disseminate. These methods and models

were chosen because they aim to produce products. The products developed were then tested for feasibility, validity, and product trials to determine the extent to which students' social skills increased after learning to use local culture-based comics.

This research will be carried out at SD Negeri Babah Krueng Even Semester for the 2022/2023 academic year in Chapter 6 of My Indonesian Rich Culture, which will be carried out in four meetings. The subjects in this study were Grade IV students, with a total of 34 students, and the object of this study was comic strip media based on local culture.

Table 2. Validation grid content eligibility, presentation feasibility, language eligibility

No	Assessment Indicator Components	descriptor
Content eligibility		
1	Material Suitability	Material completeness; Material breadth; Curriculum Depth
2	Material Accuracy	Concept accuracy; term accuracy
3	Updating the material	The suitability of the material with the child's language development; Examples and illustrative cases; update
Eligibility of Presentation		
1	Presentation technique	Presentation systematic consistency; Servant cramps; Material balance
2	Presentation Support	Introduction; Chapter introduction; Summary; bibliography
3	Learning Support	participatory interactive; Encouraging student involvement for independent and group learning that is interactive with learning resources; Encourage critical, creative and innovative thinking
4	Coherence and coherence of thought flow	Linkage and integration of meaning in chapters
Language Eligibility		
1	Accuracy	Accuracy of sentence structure; sentence effectiveness
2	Communicative	Understanding of the message
3	Appropriateness of language rules	Grammatical accuracy; Spelling accuracy; Appropriate level of intellectual development of learners
4	Appropriateness of the development of students	Appropriate level of social emotional development; Learning outcomes test enrichment material

Table. 3. Grid of Social Skills Instruments

No	Aspek	Indikator
1	*Living and working together; taking turns; respecting the rights of others; being socially sensitive.*	Work well together in study groups..
		Students are able to mingle with friends of different religions, ethnicities, and races
		Able to involve themselves in working on assignments in groups
		Respect other people's opinions
		Appreciate the work of friends
		Pay attention and listen to people who are talking or expressing opinions
		Memorize the name of the interlocutor
2	*Learning self-control and self-direction*	Comply with school regulations and health protocols (clothing, hair styling, wearing masks, keeping a safe distance from class pickets, class entry times and break times)
		Calm in conveying or demonstrate something
		Not easily angry Comply with the rules set by the teacher while in learning Obey the rules set by the teacher while in learning
		Responsibility in carrying out their duties independently
		Follow the instructions in the implementation of the project
		On time dating to school
3	*Sharing ideas and experience with others*	Express opinions during discussions..
		Look at other people's understanding and then ask questions that are appropriate to the topic
		Offers to explain or clarify his work.
		Share with friends

Table 4. Social Skills Scale Grid

Variable	Aspects	Grid
Social Skills	*Peer Relation Skill*	1. Attitude of Mentioning People's Names 2. The behavior pays attention to the person who is talking. 3. The attitude of using eye contact with others when speaking 4. Attitude accommodates the comments and ideas of others 5. Behavior participates appropriately in small talk 6. Attitude responds to rumours
	Self-management skills	1. Attitude using appropriate loudness and tone of voice 2. Attitude expresses one's own feelings when necessary
	Akademic skills	1. The behavior of paying attention to the understanding of others 2. The attitude of asking the right questions 3. Attitude maintains proper distance information 4. The attitude of asking for directions or help
Number of Questions		

To find out the practicality of comic strips, this instrument must be filled in by teachers/comic strip users, along with indicators from the comic strip practicality questionnaire.

Table 5. Practicality questionnaire grid

Observed Aspects
1. media can overcome the limitations of experience that students have
2. media can transcend classroom boundaries
3. media can allow for direct interaction between students and their environment
4. media can add basic concepts that are true, real and precise
5. the media can control the speed of student learning
6. media can provide a comprehensive experience from the concrete to the abstract

Data analysis technique
The purpose of the data analysis carried out in this study was to answer the level of validity, practicality and effectiveness of the comic strip being developed.

The Validity and Practicality of Comic Strips
Determine the Va value or the total average value of the average value for all aspects with the formula:

$$Va = \frac{\sum_{i=1}^{n} A_i}{n}$$

(Susanto, 2012:75)
With:
Va is the total average score for all aspects
A_i is the average score for the i-th aspect,
n is the number of aspects.

Table 6. Categories of Comic Quality Assessment and Student Responses

Rating Level	Category
0% - 20%	Not Good
20,1% - 40%	Not Good
40,1% - 60%	Enough
60,1% - 80%	Good
80,1% - 100%	Very Good

Analysis of students' Social Skill Sheets
The data based on the questionnaire given to the teacher needs to be calculated so that it can be presented qualitatively. The steps taken are as follows:
1. The questionnaire that was filled in by the respondent, was checked for the completeness of the answers, then arranged according to the respondent's code.
2. Quantify the answers to each question by giving a score according to a predetermined weightbelumnya.
3. Create data tabulation.
4. Calculate the percentage of the questionnaire components with the following formula:

$P_{(k)}$ = S/N x 100%

Information:
$P_{(v)}$ = percentage of components
S = total score of the components of the research results
N = maximum number of scores

According to Arikunto [31], data in the form of figures from calculations and measurements are processed by adding them up and comparing them with the expected amount to obtain a percentage. Based on this opinion, the results and calculation of the percentage of this study, the researchers interpreted the criteria into the following:

Table 7. Classification of Student Skills Questionnaire

No	Criteria	Percentage
1	Very Good	86%-100%
2	Good	76%-85%
3	Enough	60%-75%
4	Less	55%-59%
5	Less than once	< 54%

Source: Ngalim Purwanto (2006: 103)

According to Arikunto [32] the advantage of using percentages as an information tool is that with percentages the reader will find it easier to know how far each aspect contributes, related to the research being carried out. This study interprets quantitative data verbally, namely by comparing the results of the questionnaire obtained by the subject before and after being subjected to the action, then discussed descriptively from the results of the social skills questionnaire.

Comic Strip Effectiveness Analysis. The design used in this study is one group pretest and post test design as follows:

Pretest	Treatment	Post Test
O1	X	O2

Keterangan :
O1 = Pretest
X = Comic Strip Use
O2 = Posttest

After the results of learning before and after the use of comics are obtained, an N-Gain or Gain Score analysis is then carried out to see the effectiveness of comic strips. Statistical analysis of student learning outcomes uses the following hypothesis:
Ho: There is no difference in student learning outcomes before and after using local culture-based comic strips.
Ha : There are differences in student learning outcomes before and after the use of local culture-based comic strips.

The data analysis technique used to assess and determine the increase in student learning outcomes is gain-normalized analysis. The normalized gain, or N-gain score, aims to determine the effectiveness of using a particular method or treatment in research. The N-gain score test is carried out by calculating the difference between the pre-test scores and post-test scores. By calculating the difference between the pre-test and post-test values, or the gain score, we can find out whether the use or application of a particular method can be said to be effective or not.

$$g = \frac{Tf - Ti}{SI - Ti}$$

Information :
g = Normalized gain
Tf = Post-test score
Ti = Pre-test score
SI = Ideal score

Table 8. Interpretation of Normalized Score Gain

Besar Persentase	Interpretasi
Gain > 0,7	High Boost
0,3<Gain <0,7	Moderate Increase
Gain<0,3	Low Gain

3. RESULTS AND DISCUSSION
3.1 RESULTS

Assessment results by Validation of Linguists; Material Expert Validation; Learning Design Validation; Small Group Trial; Large Group Trial for all aspects of the assessment is determined by the average score. The results of the assessment are then analyzed and determined whether or not it is appropriate to develop comic strip media based on Local Culture. The average percentage of the results of the assessment is in table 9 below:

Table 9. Feasibility of comic strip media based on local culture

No	Categorization	Percentage of average score %	Criteria
1.	Linguist Validation	93,00	very feasible
2.	Material Expert Validation	83,00	very feasible
3.	Learning Design Validation	61,00	feasible
4.	Small Group Trial	70,00	feasible
5.	Large Group Trial	76,00	feasible
The average		76,60	very feasible

The practicality test for users regarding the user's or teacher's response to comic media is 30. The results of this trial then use the existing formula; the total score of the trial in percent is 90%. Thus, the results of the pilot study fall into the "very good/very practical" category.

In trial I, students were given 15 multiple-choice questions as test instruments in the pre-test and post-test, which were then tested for Gain Score. The pre-test and post-test were attended by 34 students. In general, data analysis on the effectiveness of learning media used by students in the Gain Score test It can be seen that there was an increase, where the total score at the time of the pretest was 55.10 and at the time of the posttest was 82.94.

In measuring the level of student skills, there are three aspects: peer relationship skills, self-management skills, and academic skills. The results of the questionnaire before learning were carried out using comic-book learning media. shows that the average percentage of the 34 students in the school only reaches 75%, which, if adjusted to table 3.7, is in the "good" category. Therefore, it is necessary to do a treatment in the form of applying comic scripts to learning.

An observation of student activity was carried out to determine the level of students' social skills during learning using Comic Strip media. The social skills expected by researchers include living and working together, taking turns, respecting the rights of others, being socially sensitive, Learning self-control and self-direction, and sharing ideas and experiences with others. The average of the results of student activity can be seen from the table above, namely 3.73. The average effect on the assessment of students' social skills is to find out the value of each student based on the achievement category of each student. Student activity sheets that focus on social skills obtain a preset value of 75%, which is in the range of 61% to 80% with the achievement criteria "Good".

3.2 DISCUSSION

To test the level of validity of the presentation expert component with indicators such as consistency of presentation systematics, Consistency of presentation, Balance of presentation of material, Introduction, Introduction to Chapters, Summary, Bibliography, Participatory Interactive, Encouraging student involvement in independent learning and interactive groups with learning resources; encouraging critical, creative, and innovative thinking; and linking and integrating meaning in chapters. The score obtained is only 15, where the maximum score of the assessment is 55. If the percentage of the score obtained from the analysis of linguists is only 27%. category "Not Good" with the conclusion "Easy to use in the field with revisions" with several revisions: (1) Summary, (2) Bibliography. (3) Participatory Interactive, (4) Linkage and Integration of Meaning in Chapters After the comic has been repaired or revised according to the directions from the validator, the score obtained is 30, where the maximum score from the assessment is 55. If the percentage of the score obtained from the results of the analysis by content feasibility experts reaches 61%, These results, when referring to Table 3.5, are included in the "Good" category with the conclusion "Easy to use with revision".

Based on the results of calculations and descriptions of each aspect of language validation, content eligibility validation, and presentation feasibility, it can be concluded that the results of the validation test for local culture-based comic strip media have fulfilled the validity criteria. According to Soedarso [33], the comic strip is the development of serial Folklore comic media, which is presented with a series of images that are presented briefly and serially and do not beat around the bush in their delivery. Cartoon images in comics can be the first thing readers see to enter into the story that will be conveyed; therefore, the selection of images in comics must be considered. Comic media also uses various colors to make it look more attractive.

After conducting validation tests on 3 experts, the researcher continued the comic practicality test stage, which was divided into 2 stages, namely small or limited group trials, which were attended by 5 students in grade 4 of SD Negeri Babah Krueng. Small-group trial data were obtained from a questionnaire and analyzed as a basis for improvement. The result of the 10 statements submitted and filled in by 5 respondents obtained an average score of 3.52 and a percentage of 70%.

Furthermore, after repairs were made, the researchers conducted a large-scale trial; the instruments used were still the same, only the number of respondents was increased to 34 grade 4 students at SDN Babah Krueng. obtained a large group trial consisting of 10 statements submitted and assessed by 34 respondents. Data from large group trials show that comics are included in the "good" criteria. This can be seen from the average results obtained at 3.82 and, if percentaged, at 76%. From the testing activities of the large group of enthusiastic students using local culture-based comics that were developed.

The study revealed an interesting finding: students seemed more interested in learning by viewing media before learning

actually started. Students were very enthusiastic about seeing photos and discussing with their classmates the visuals and stories in comic media. Students concentrate on listening and understanding the explanations given during the explanation of the contents so that they are not confused when reading comic books and can easily complete the assessment. When students copied the stories in their own sentences, it was seen that the stories they wrote were acceptable and no narrative components were forgotten, making it easier for students to understand the contents of the stories they read while studying. As revealed by Gunawan & Sujarwo (2022), data on the practicality of comics was obtained from student practicality sheets, which were filled in by students who used comics during practicality tests. Comics that were developed were said to be practical if the criteria for practicality were practical or very practical.

This criterion is in accordance with previous research conducted by Gunawan and Sujarwo [35], where the practicality aspect of comic books was measured using a student response questionnaire. The distribution of student response questionnaires was carried out after students read and understood the contents of the comic book. The practicality of teaching materials is related to their ease of use.

Product effectiveness can be seen from the pretest and posttest trials conducted and analyzed with the Gain Score test. The pre test and post test were attended by 34 students. The percentage of the average student score in the gain score test was 0.62. If it is associated with the interpretation table, the increase in student learning outcomes traditionally associated with the gains from the core test is in the "Medium" category. This states that students in Class IV have fulfilled the percentage of classical completeness and are categorized as effective because they can improve student learning outcomes.

Based on the information above, it can be indicated that, in general, students are able to absorb lessons when the teaching and learning process uses comics, and there is a significant difference in effectiveness between learning using comics and without using comics. This is in line with Santo Santoso's opinion, Seni Apriliya [36], which states that comics have the ability to create student interest in learning and help students make it easier to remember the learning material they are studying.

The effectiveness of comics can also be seen from student activities by conducting observation sheets to determine the level of student skills, including living and working together, taking turns, respecting the rights of others, being socially sensitive, Learning self-control and self-direction, and sharing ideas and experiences with others. The average of the results of student activity can be seen from the table above, namely 3.73. The average effect on the assessment of students' social skills is to find out the value of each student based on the achievement category of each student. Student activity sheets that focus on social skills obtain a preset value of 75%, which is in the range of 61% to 80% with Good achievement criteria.

Effectiveness and efficiency mean that the success of learning is measured by the level of achievement of the objectives after the learning has been carried out. If the learning objectives are achieved, the learning is said to be effective; if the achievement of learning objectives using the media is minimal, then the learning is said to be efficient [37]. Effective and efficient media can support learning achievement. In this case, the purpose of this research is to improve students' skills, and with

the results obtained, the comics developed are in the Effective category.

The results of this study can be compared with those of other studies. This research is different from previous research conducted by Jois Nilantira (2015) with the title Development of Folklore Comic Media for Fiction Writing Skills for Grade IV Elementary School Students. In the previous research, the media was developed for writing skills, while in this research it was developed for students' social skills. In this study, it was tested on students by measuring the effectiveness of the media, so that student test results became a reference for research results. Meanwhile, in this study, in addition to using student learning outcomes tests, instruments were also used to measure students' social skills improvement.

4. CONCLUSION

1. From the results of the validity test of three experts, namely linguists, presentation experts, and content feasibility experts, the results are: (1) The percentage of scores obtained from the results of the analysis of linguists reaches 93%. These results fall into the category of "Very Good". (2) The percentage of scores obtained from the results of the content feasibility expert analysis reaches 61%. These results fall into the category of "Good". (3) The percentage of scores obtained from the results of the content feasibility expert analysis reaches 61%. Results in category "Good".

2. From the results of the Practicality Test, it is determined that the total score of the trials in percent is 90%. Thus, the results of the pilot study fall into the "very good/very practical" category.

3. From the results of the Effectiveness test obtained, the gain score, or increased learning outcomes seen from the pretest and protest, shows an increase in the classical average score of 0.6. Referring to the gain score interpretation table, these results indicate an increase in "Good" learning outcomes. Therefore, comic strips have been said to be effective in increasing learning outcomes.

4. From the results of the assessment of the social skills questionnaire filled out by the teacher before using comics, the average percentage of 34 students at the school only reached 75% in the good category. very good category. With the difference in the results above between the pretest and posttest, it further emphasizes that comic media can improve students' social skills. From the results of observations of student activities, a preset value of 75% was obtained, which was in the range of 61% to 80% with good achievement criteria.

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INOLYN Learning Model Based on Blended Learning: Improving Learning Outcomes for Basics of Beauty and SPA Vocational School Students

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Abstract: The purpose of this study was to determine the feasibility of the blended learning-based INOLYN learning model that had been designed for the basics of beauty and SPA subjects, the practicality of the blended learning-based INOLYN learning model that has been designed for the basics of beauty and SPA subjects, and the effectiveness of the blended learning-based INOLYN learning model that has been designed for the basics of beauty and SPA subjects. This type of research is called research and Development (R&D) research. This development research was conducted at SMK Negeri 10 Medan. The subjects in this study were students of Class X Beauty at SMK Negeri 10. The object of research was manual facial skin care materials. The results showed that: (1) the INOLYN learning model based on blended learning in the basics of beauty and SPA subjects was declared feasible to use; (2) the INOLYN learning model based on blended learning in the basics of beauty and SPA subjects is practically used; and (3) the INOLYN learning model is effective in increasing the learning outcomes of the basics of beauty and SPA compared to using the discovery learning model because tcount = 2.04 > ttable = 1.66, so it is concluded that the learning outcomes of students using the INOLYN learning model are higher than the learning model of discovery learning. In this case, the INOLYN learning model based on blended learning is 72.60% higher than that using the discovery learning model, which is 65.33%.

Keywords: learning models; INOLYN; blended learning; beauty basics; and SPA

1. INTRODUCTION

Technological developments in education enable distance learning to occur using platforms connected to the internet that can connect and make it easier for teachers and students to interact, like the learning process in the classroom. Technological developments provide benefits for education, which can be seen in the creation of learning platforms that make it easier for students to learn, one of which is Google Classroom. Google Classroom is a digital learning platform that can be connected to a variety of other digital resources that can connect users. The Google Classroom platform is increasingly being used as a student learning aid with content desired by teachers or instructors.

Creating effective learning is strongly influenced by supporting and inhibiting factors that exist in each school. Schools must be able to adapt and be open to changes that arise as new technologies and innovations develop in the era of the Industrial Revolution 4.0. Until now, the application of learning models has begun to innovate a lot and utilize more sophisticated and practical technologies. The success of students in achieving their learning goals is also inseparable from the accuracy of the teacher in selecting and implementing learning models in the classroom.

SMK Negeri 10 Medan is one of the SMKs in the city of Medan. One of the majors at SMK Negeri 10 Medan is Cosmetology. One of the subjects in Cosmetology is the Basics of Beauty and SPA. In this subject, there are eight elements of learning material, one of which is the basic practice of skin and hair beauty. The basic practice material for skin and hair beauty includes caring for facial skin without problems, applying daily makeup, caring for hands and coloring nails, caring for feet, and coloring nails, while the scope of learning hair beauty includes washing hair, caring for scalp and hair, drying hair with a dryer, and doing hair styling.

1.1 The Nature of the Facial Skin Care Learning Model

Smaldino et al. [1] stated that the model is a three-dimensional representation of real objects. Law and Kelton [2] argue that a model is a representation of a system that is seen as representing the real system. The same thing was also stated by Richey et al. [3], who stated that a model is a representation of reality that is presented with a level of structure and regularity as well as a simplified ideal form of reality. Furthermore, Snelbecker [4] explains that the model is a concretization of theory that aims to act as an intermediary for the processes and variables contained in the theory. Briggs [5] explains that a model is a set of sequential procedures to realize a process, such as needs assessment, media selection, and evaluation.

Furthermore, Slavin [6] states that the learning model is a reference to a learning approach, including its goals, syntax, environment, and management system. The same thing was also expressed by Arends [7], who stated that the learning model is a conceptual framework that describes systematic procedures in organizing learning experiences in order to achieve learning competence, and the learning model refers to the learning approach to be used, including teaching objectives, stages in learning activities, the learning environment, and classroom management.

Furthermore, Joyce and Weil [8] put forward five important elements that describe a learning model, namely: (1) Syntax, which is a rule and sequence of learning, which is usually also called a phase; (2) The social system, namely the role of students and teachers and the necessary norms; (3) The principle of reaction, namely giving an overview to the teacher about how to perceive and respond to what students do; (4) Support systems, namely conditions or requirements needed for the implementation of a model, such as classroom settings, instructional systems, learning tools, learning facilities, and learning media; and (5) Instructional and accompanying impacts.

According to Rachmi [9], facial skin care is the most important action to maintain the health and fitness of facial skin so that facial skin is protected from dead skin cells, dust, dirt, and remnants of make-up that stick to facial skin, and also to avoid the occurrence of various skin problems. This is in line with Tresna's statement [10], which states that facial skin care can help maintain and improve healthy skin function because facial skin cannot be free from dirt, both dust and cosmetics that stick to the skin, especially for someone who travels.

Figure 1. INOLYN teaching materials and learning models based on blended learning

1.2 INOLYN Learning Model

The INOLYN learning model develops a learning concept with an active student approach. This model is oriented towards project-based learning and uses the internet as a learning tool. The INOLYN learning model, as a concept, can be interpreted as a learning approach that involves several methods to provide meaningful experiences to students. It is said to be meaningful because, in the INOLYN learning model, students will understand the concepts they learn through direct experience and relate them to other concepts they already understand by integrating the internet as a learning resource. The focus of the INOLYN learning model lies in the process that students take when trying to understand the content of learning in line with the types of skills that must be developed.

The implementation of the developed INOLYN learning model consists of two elements, namely students and teachers. The activities that will be carried out by students are: (1) carrying out learning in class according to the lesson plan prepared by the teacher; (2) carrying out learning outside of school according to the assignments given by the teacher; and (3) Obtaining learning assistance from the teacher. The activities that will be carried out by the teacher are: (1) Planning and developing the INOLYN learning model; (2) Providing general and specific information, communication, and learning about the INOLYN learning model; (3) Providing learning facilities in class using the INOLYN learning model; (4) carrying out monitoring in class; and (5) carrying out an evaluation of student learning in class using the INOLYN learning model.
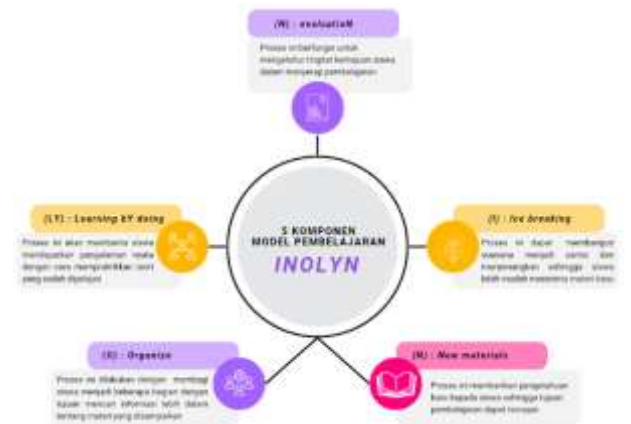

Figure 2. Components of the INOLYN Learning Model

A good learning model must have a clear syntax. The syntax of the INOLYN learning model can be seen in Table 2.1 below: (1) I: Ice Breaking: Activities for "breaking ice" that make students feel more relaxed and comfortable in receiving lessons; (2) N: New Materials: Materials are given to students and selected as optimally as possible to help students achieve their learning goals; (3) O: Organize: The process of organizing and forming students into several parts to carry out deep information or deepening of information as a basis for implementing the learning by doing phase Reconstructing knowledge through assimilation and accommodation processes based on the results of analysis, discussion, and formulation of conclusions from the information provided; (4) LY: Learning by doing: Through learning by doing activities in the INOLYN learning model, students will show more creativity so that they are able to create something new either in the form of ideas, work, or concrete actions that can be useful for life; and (5) N: evaluation: Reconstructing knowledge through the process of assimilation and accommodation starting from the results of analysis, discussion, and formulation of conclusions from the information obtained.

1.3 The Nature of Blended Learning

Watson [11] states that blended learning is a learning activity that integrates face-to-face learning with online learning and aims to improve an active learning atmosphere by having discussions between students and teachers. Thorne [12] defines blended learning as a mixture of e-learning and multimedia technologies, such as video streaming, virtual classes, and online text animations, combined with traditional forms of classroom training. The same thing was also stated by Driscoll [13], who stated that blended learning is learning that combines or combines various web-based technologies, to achieve educational goals. Furthermore, Armitege et al. [14] stated that blended learning is learning that involves students using online and non-electronic resources by mixing distance and face-to-face learning methods.

Stein & Graham [15] stated that blended learning combines face-to-face learning with online learning to produce effective, efficient, and flexible learning. Even Cheung & Hew [16] stated in their research that blended learning can improve student communication through synchronous and asynchronous communication technologies. In addition, this learning also provides opportunities for students to meet each other, improves communication between students, reduces costs per student, improves student learning outcomes, and improves the quality of educational institutions. Even Ying & Yang [17] in their research support students ability to access subject matter, carry out online learning activities flexibly, and learn directly in class.

According to Brooke [18], there are four models that are generally implemented in blended learning, including the Rotation model, the flex model, the a la carte model, and the enriched virtual model. Lilina, Rankine, & Cortez [19] stated that the implementation of blended learning in the learning process was found to vary greatly according to the disciplines being taught, student characteristics and learning outcomes, and having a student-centered approach to learning design.

Pradana and Rina [20] explained about Google Classroom, which is a classroom application in cyberspace that can be a means of distributing assignments, submitting assignments, and assessing assignments that have been submitted by students. This application can be obtained free of charge after previously registering with a Google Application for Education account. Class [21] quotes from the official Google website: The Google Classroom application is a free productivity tool, including email, documents, and storage. Classrooms are designed to make it easier for teachers to save time, manage classes, and improve communication with their students. With Google Classroom, it can be easier for students and teachers to connect with each other inside and outside of school. The same thing was emphasized by Asnawi [22]: the Google Classroom application is a blended learning platform intended for every scope of education as a way out of difficulties in making, distributing, and grouping each paperless assignment. This app is one of the best platforms to improve teacher workflow.

The research problem is formulated as follows: (1) Is the INOLYN learning model based on blended learning that has been designed in the subjects of the basics of beauty and SPA suitable for use in the learning process? (2) Is the INOLYN learning model based on blended learning that has been designed in the subjects of the basics of beauty and SPA practically used? And can the INOLYN learning model based on blended learning that has been designed in the subjects of

the basics of beauty and SPA be effective in improving student learning outcomes?

2. METHOD

This type of research is Research and Development (R&D) development research. Sukmadinata [23] Research and Development (Research and Development) is a process or steps to develop a new product or improve existing products, which can be accounted for. Richey and Klein [24] stated that R&D research is a systematic study related to design, development and evaluation that aims to develop products that are educational or not, related to the latest findings of products and devices. In this study the development carried out was the development of the INOLYN learning model based on blended learning.

This development research was conducted at SMK Negeri 10 Medan. The subjects in this study were students of class X Beauty at SMK Negeri 10 Medan for the 2022/2023 school year, model expert validators, material experts and learning design experts. The object of research is manual facial skin care material.
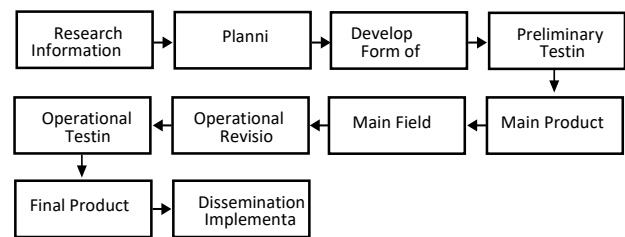

Figure 3. Borg & Gall Development Model (Source: Borg & Gall [25])

Table 1. Feasibility Interpretation

Score Interval	Criterion	
0.00 – 2.49	Not Good	Not feasible
2.50 – 3.32	Less Good	Less Eligible
3.33 – 4.16	Fine	Worthy
4.17 – 5.00	Very good	Very Worth it

(Source : Sriadhi [26])

This research was said to be successful if the results obtained from the questionnaire met the criteria of "Very Good" or "Very Eligible" and "Good" or "Decent" with a score interval of 3.33-5.00.

The practicality of the learning model developed in this study was measured using a questionnaire assessing the use of the learning model in the learning process. The practicality value can be calculated using the formula in Table 2 below:

Table 2. Criteria for the Practicality of the Learning Model

Score Interval	Criterion
3,5 – 4,00	Very Practical
3,00 – 3,49	Practically Without Repair
2,50 – 2,99	Practically Needs Improvement
2,00 – 2,49	Less Practical
1,00 – 1,99	Impractical

The effectiveness of the learning model developed depends on having two types of data, namely qualitative and quantitative. Qualitative data is generated from preliminary or feasibility

studies, either in literature studies or field studies. Quantitative data were obtained from student learning outcomes using quasi-experiments, namely comparing pre-test and post-test scores of students using the developed INOLYN learning model. In this study, the data obtained were student learning outcomes from the experimental and control classes with the assessment criteria as seen in Table 3 below:

Table 3. Assessment Criteria

Value	Criteria	Percentage (%)
A	Very Good	81-100%
B	Good	61-80%
C	Enough	41-60%
D	Less Good	21-40%
E	Very Poor	0-20%

Data collection was carried out using a questionnaire by distributing questionnaires to the respondents, namely material experts, media experts, design experts, and students. The respondents gave an assessment of the quality of the INOLYN learning model based on blended learning with the following research criteria:

Table 4. Scoring Rules

No	Category	Score
1	Very good	5
2	Good	4
3	Pretty good	3
4	Not good	2
5	Not good	1

(Source: Arikunto, [31])

The research results of each respondent calculated the average score obtained. The average score obtained is then converted into a qualitative value using the formula and basic guidelines to determine the level of validity as follows:

$$P = \frac{\sum x}{\sum x^1} \times 100\%$$

Information:
P = Large Percentage
$\sum x$ = Number of Validator Answer Scores
$\sum x^1$ = Total Highest Answer Score

Table 5. Product Validation Criteria

Percentage %	Validity Level	Information
80 – 100	Very valid	Not Revised
60 – 79	Valid	Not Revised
40 – 59	Invalid	Some Revisions
20 – 39	Invalid	Revision
0 - 19	Very invalid	Revision

(Source:: Arikunto [27])

Data Analysis of the Effectiveness of the INOLYN learning model based on blended learning

Normality test.
To determine the average value, the formula is used, namely:

$$\bar{x} = \frac{\sum f_i \, x_i}{\sum f_i}$$

To calculate the standard deviation (s), the formula is used, namely:

$$s = \sqrt{\frac{n \sum x_i^2 - \left(\sum x_i\right)^2}{n(n-1)}}$$

By testing criteria:
If Lo < Lt then the sample is normally distributed and if Lo > Lt then the sample is not normally distributed

Homogeneity Test.
Examination of the variance homogeneity test aims to determine whether the sample data has a homogeneous variance or not. Test the homogeneity of variance using the F test, with the following hypotheses:

$H_0 : \sigma_1^2 = \sigma_2^2$ the two populations have the same variance..

$H_a : \sigma_1^2 \neq \sigma_2^2$ the two populations have different variances

$$F_{hit} = \frac{varians\ terbesar}{varians\ terkecil}$$

Kriteria Pengujian adalah :
$F_{hit} < F_{tab1/2\ \alpha(v1, v2)}$, Ho accepted
$F_{hit} > F_{tab1/2\ \alpha(v1, v2)}$, Ho is rejected

Data processing shows that Fcount < Ftable, then H0 is accepted. It can be concluded that the two samples have a homogeneous variance. If data processing shows that Fcount > Ftable, then H0 is rejected and Ha is accepted, it can be concluded that the two samples do not have a homogeneous variance..

Research Hypothesis Test.
Testing the hypothesis in this study was carried out using the one-party t-test formula where the statistical hypothesis being tested can be formulated as follows:
Ha: here are differences in the learning outcomes of students who study using the INOLYN learning model based on blended learning and students who study with conventional learning media.
H0: There is no difference in the learning outcomes of students who study using the INOLYN learning model based on blended learning and students who study with conventional learning media.
To find out the significant differences of student learning outcomes. The t test formula is as follows:

$$t = \frac{\overline{X}_1 - \overline{X}_2}{s\sqrt{\dfrac{1}{n_1} + \dfrac{1}{n_2}}}$$

The test criteria are that Ha is accepted if tcount < ttable and Ho is rejected if tcount > ttable which is obtained from the t distribution list with dk = (n − 1) and level α = 5%. To see the value of the effectiveness of the blended learning-based INOLYN learning model that is being experimented on, the effectiveness calculation formula is used as follows:

$$X = \frac{number\ of\ students\ who\ completed}{total\ number\ of\ students} \times 100\%$$

3. RESULTS AND DISCUSSION
3.1 RESULTS
The results of the assessment by media experts, material experts, individual trials, small group trials, and limited field trials for all aspects of the assessment are determined by the average score. The results of the assessment were then analyzed and determined whether or not it was appropriate to develop the INOLYN learning model based on blended learning. The average percentage of the results of the assessment of media experts, material experts, individual trials, small group trials, and field trials is shown in Table 6 below:

Table 6. The feasibility of the INOLYN learning model based on blended learning

No	Categorization	Percentage of average score%	Criteria
1.	Material Expert Validation	4,24	Is very feasible
2.	Media Expert Validation	4,41	Is very feasible
3.	Learning Design Validation	4,69	Is very feasible
4.	Preliminary Field Test	3,92	Is very feasible
5.	Main Trial	4,32	Is very feasible
6.	Operational Trial	4,78	Is very feasible
Average		4,39	Is very feasible

Based on Table 6, it can be concluded that the scoring intervals for material expert validation, media expert validation, learning design validation, initial field trials, main trials, and operational trials show an average of 4.39 with very feasible criteria. So the application of the INOLYN learning model based on blended learning is very feasible and appropriate to be taught to class X Beauty Counseling students at SMK Negeri 10 Medan.

The initial field practicality test was carried out in Class X Beauty at SMK Negeri 10 Medan. The practicality test was conducted on five students. The results of the practicality test in the initial field were in the form of an assessment score on the INOLYN learning model based on blended learning on manual facial skin care material, which can be seen in table 7 below:

Tabel 7. Kepraktisan model pembelajaran INOLYN berbasis blended learning

No	Categorization	Percentage of average score%	Criteria
1.	Criteria	3,30	Is very feasible
2.	Main Trial	3,68	Is very feasible
3.	Operational Trial	3,82	Is very feasible
Average		3,60	Is very feasible

Based on Table 7, it can be concluded that the score intervals for the initial field trials, main trials, and operational trials show an average of 4.56 with very practical criteria. So the application of the INOLYN learning model based on blended learning is very feasible and appropriate to be taught to class X Beauty Counseling students at SMK Negeri 10 Medan.

The pre-test learning outcomes of students who were taught using the INOLYN learning model based on Blended Learning obtained the lowest score of 28 and the highest score of 76, an average score of 51.93, and a standard deviation of 13.14. The frequency distribution of student pretest learning outcomes

taught using the Blended Learning-Based INOLYN learning model can be seen in Table 8 below:

Table 8. Frequency Distribution of Students' Pretest Learning Outcomes Taught Using the INOLYN Learning Model Based on Blended Learning

Class	Interval Class	Absolute Frequency	Relative Frequency
1	28-35	4	12,12%
2	36-43	5	15,15%
3	44-51	7	21,21%
4	52-59	4	12,12%
5	60-67	7	21,21%
6	68-75	6	18,18%
Total		33	100%

The post-test learning outcomes of students who were taught using the INOLYN learning model based on Blended Learning obtained the lowest score of 52 and the highest score of 92, with an average value of 108.90 and a standard deviation of 14.80. The frequency distribution of posttest learning outcomes of students who are taught using the INOLYN learning model based on Blended Learning can be seen in Table 9 below:

Table 9. Frequency Distribution of Posttest Learning Outcomes of Students Taught Using the INOLYN Learning Model Based on Blended Learning

Class	Interval Class	Absolute Frequency	Relative Frequency
1	52-58	3	9,09%
2	59-65	5	15,15%
3	66-72	12	36,36%
4	73-78	5	15,15%
5	79-85	4	12,12%
6	86-92	4	12,12%
Total		33	100%

The pre-test learning outcomes of students taught using the Discovery Learning learning model obtained the lowest score of 24 and the highest score of 68, with an average value of 64.90 and a standard deviation of 15.59. The frequency distribution of student pretest learning outcomes taught using the Discovery Learning learning model can be seen in Table 10 below:

Table 10 Frequency Distribution of Students' Pretest Learning Outcomes Taught Using the Discovery Learning Learning Model

Class	Interval Class	Absolute Frequency	Relative Frequency
1	24-31	2	6,060%
1	32-39	10	30,30%
2	40-47	6	18,19%
3	48-55	9	27,27%
4	56-63	5	15,15%
5	64-71	1	3,030%
6	24-31	2	6,060%
Total		33	100%

The post-test learning outcomes of students who were taught using the Discovery Learning learning model obtained the lowest score of 48 and the highest score of 84, with an average value of 97.27 and a standard deviation of 14.36. The frequency distribution of student pretest learning outcomes taught using

the Discovery Learning learning model can be seen in Table 11 below:

Table 11. Frequency Distribution of Posttest Learning Outcomes of Students Taught Using the Discovery Learning Learning Model

Class	Interval Class	Absolute Frequency	Relative Frequency
1	48-53	3	9,090%
1	54-59	7	21,21%
2	60-65	7	21,21%
3	66-71	5	21,21%
4	72-77	7	15,15%
5	78-84	4	12,12%
	48-53	3	9,090%
Total		33	100%

Data normality checks are used to determine whether the sample comes from a normally distributed population. The test was carried out using the Liliefors test on two sample groups. A summary of the data normality test can be seen in Table 12 below:

Table 12. Summary of Data Normality Test

No	Class	L count	L table	Conclusion
1	Student learning outcomes taught using the INOLYN learning model based on Blended Learning	0,13	0.154	Normal
2	Student learning outcomes taught using the Discovery Learning learning model	0,135	0.154	Normal

In the table above, it is found that the data on student learning outcomes taught using the INOLYN learning model based on Blended Learning is normally distributed. This is known from the large Lcount <Ltable at a significant level of 5%, namely 0.13 < 0.154. Data on learning outcomes taught using the Discovery Learning learning model is normally distributed. This is known from the large Lcount < Ltable at a significant level of 5%, namely 0.135 <0.154.

To test the homogeneity of the research data, Fisher's test was used. Based on the calculation of homogeneity, it is concluded that the data on student learning outcomes taught using the INOLYN learning model based on Blended Learning is homogeneous. It is known from the Fcount < Ftable at a significant level of 5%, namely Fcount (1.52) < Ftable (1.80). Data on student learning outcomes that are taught using the Discovery Learning learning model is homogeneous. It is known from the Fcount < Ftable at a significant level of 5%, namely Fcount (1.10) < Ftable (1.80). A summary of the homogeneity test can be seen in Table 13 below:

Table 13. Summary of Data Homogeneity Test

No	Class	F count	F table	Conclusion
1	Student learning outcomes taught using the INOLYN learning model based on Blended Learning	(1,52)	(1,80)	Homogeneous
2	Student learning outcomes taught using the Discovery Learning learning model	(1,10)	(1,80)	Homogeneous

Learning Outcomes of Students Using the INOLYN Learning Model Based on Blended Learning in the Subject of Fundamentals of Beauty and SPA Class X SMK Negeri 10 Medan are Higher Than Learning Outcomes Using the Discovery Learning Learning Model. Testing the hypothesis used is a different test. From the calculation results obtained, tcount = 2.04 and ttable = 1.66. Because tcount = 2.04 > ttable = 1.66, it can be concluded that the learning outcomes of students using the INOLYN learning model based on blended learning are higher than the learning outcomes of students using the discovery learning model. A summary of the hypothesis testing can be seen in Table 14 below:

Table 14 Summary of Hypothesis Test Calculations

Average Posttest Value		t_{hitung}	t_{tabel}	Conclusion
Using the INOLYN learning model based on Blended Learning	Using the Discovery Learning learning model	2,04	1,66	There is a significant difference
72,60%	65,33%			

From the results of testing the hypothesis, empirical evidence is obtained that student learning outcomes using the INOLYN learning model based on blended learning are higher than student learning outcomes using the discovery learning model.

The effectiveness of the inolyn learning model based on blended learning in the basics of beauty and SPA subjects is as follows:

$$x = \frac{\text{Total score obtained}}{\text{Total ideal score}} \times 100\%$$
$$x = \frac{2396}{3300} \times 100\% = 72,60\%$$

While the effectiveness of learning by using the learning model of discovery learning

$$x = \frac{\text{Total score obtained}}{\text{Total ideal score}} \times 100\%$$
$$x = \frac{2156}{3300} \times 100\% = 65,33\%$$

Thus the value of the effectiveness of the INOLYN learning model based on blended learning in the basics of beauty and SPA subjects is higher than the discovery learning model.

3.2 DISCUSSION

Aunurrahman [28] states that student activity in learning is an important and fundamental issue that must be understood and developed by teachers in the learning process. This was also stated by Trinandita [29], who stated that the most basic thing

required in the learning process is student activity. The benefits obtained by using the INOLYN learning model based on blended learning in the basics of beauty and SPA subjects provide active, creative, and innovative learning between students and teachers. The INOLYN learning model will also provide students with real-life learning experiences so they can better understand learning. This is in line with Kolb [30], who stated that learning experiences actually have a major role in learning so that they can increase the effectiveness and results of learning itself.

Based on the explanation above, it can be concluded that the INOLYN learning model based on blended learning is proven to be feasible to use because it has passed the material, media, and instructional design validation tests. It was even tested in initial field tests, main field tests, and operational field tests, and the average results were declared "very good".

The INOLYN learning model can be used online and face-to-face, which will make learning happen anywhere and anytime. Learning with technology and a combination of face-to-face learning can produce more effective and efficient learning. This is in line with Sagala [31], who states that by using a variety of learning variations, it can increase student enthusiasm for learning. The step taken to see the results of practicality is to fill out a response questionnaire filled out by students.

Based on the results of research data processing conducted to see the practicality of the blended learning-based learning model, it is evident that the INOLYN learning model is practically used in the learning process. This can be proven by the average practicality test results in the initial, main, and operational fields, which meet the criteria of "very practical."

Blended learning can accommodate broad technological developments without having to leave face-to-face learning in class by combining face-to-face learning and e-learning so that students can continue learning and communication in the learning process can run smoothly. This is in line with Comey's statement [32], which states that communication plays an important role in the learning process and is the key to creating an effective learning environment. Then Fauziah et al. [33] stated that the Google Classroom platform has advantages in helping teachers create and manage class assignments quickly and easily, provide direct feedback to students efficiently, and communicate with students without being limited by space and time.

Based on the results of research data processing, there were differences in student learning outcomes using the INOLYN learning model based on blended learning in the basics of beauty and SPA subjects with students using the discovery learning model, namely the average value of the basics of beauty and SPA subjects, especially in manual facial skin care material taught using the INOLYN learning model based on blended learning, is higher than that using the discovery learning model based on the results of the t test, obtained tcount = 2.04 while ttable = 1.66. Because tcount = 2.04 > ttable = 1.66, it can be concluded that the learning outcomes of students using the INOLYN learning model based on blended learning are higher than the learning outcomes of students using the discovery learning model.

This can be seen from the average value of the basics of beauty and SPA taught using the blended learning-based INOLYN learning model, which is 72.60% higher than that using the discovery learning model, which is 65.33%. This data proves that the INOLYN learning model based on blended learning can improve student learning outcomes. What makes the INOLYN learning model advantageous compared to discovery learning is that students become more enthusiastic, active, creative, and innovative in the learning process. The difference in learning outcomes for the basics of beauty and SPA, especially in manual facial skin care materials using the INOLYN learning model based on blended learning using the discovery learning model, is 7.27%.

4. CONCLUSION

1. The INOLYN learning model, based on blended learning in the basics of beauty and SPA subjects, is declared feasible. This can be seen in the results of the interval scores of material experts (4.24 with the criteria of "very good), media experts (4.41 with the criteria of "very feasible), and instructional design experts (4.69 with the criteria of "very This can be seen in the results of the interval scores of material experts (4.24 with the criteria of "very good"), media experts (4.41 with the criteria of "very feasible"), and instructional design experts (4.69 with the criteria of "very feasible"). Meanwhile, the initial field trials received a score interval of 3.92 with "good" criteria, 4.32 for main field trials with "very good" criteria, and 4.78 for operational field trials with "very feasible" criteria.

2. The INOLYN learning model, based on blended learning in the basics of beauty and SPA subjects, is practically used in learning. The results of the practicality test on the initial field get a score interval of 3.40 in the "practical" category, the results of the practicality test on the main field get an interval score of 3.68 in the "very practical" category; and the results of the practicality test in the operational field get an interval score of 3.82 in the "very practical category.

3. The use of the INOLYN learning model is more effective in improving learning outcomes in the basics of beauty and SPA compared to using the discovery learning model because tcount = 2.04 > ttable = 1.66, so it is concluded that the learning outcomes of students using the INOLYN learning model are based on blended learning more than the learning model of discovery learning. In this case, the INOLYN learning model based on blended learning is 72.60% higher than that using the discovery learning model, which is 65.33%.

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Project-Based Learning Audio-Visual Learning Media: Improving Chemistry Learning Outcomes

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Abstract: This study aims to analyze the feasibility of audio-visual media based on project-based learning assisted by the Adobe Flash CS4 application on electrolyte and non-electrolyte solutions and the effectiveness of audio-visual media based on project-based learning for class X Electrolyte and non-electrolyte solutions. The research method used in this study refers to Borg and Gall, which was carried out at the Bina Bersaudara Private High School in Kec.Selesai, which is located on Jalan Jamin Ginting, Kuta Parit, Kec. Done Langkat Regency. Class X IPA I and Class X IPA II Academic years 2022-2023 There are 40 (forty) students in class X IPA 1 and students in class X IPA II, totaling 32 (thirty-two) students from SMA Bina Bersaudara Kec. The results showed that: (1) project-based learning-based audio-visual media assisted by the Adobe Flash CS4 application that has been tested has obtained a percentage value of 86% with the criteria of "very feasible" to be used in the material for electrolyte solutions and non-electrolyte solutions for class X IPA. and (2) Audio-visual media based on project-based learning assisted by the Adobe Flash CS4 application, which has been tested, gets a score of 95% with the criteria of "effective" and obtains t table -2172 < t count < 2.172 so that Ho is rejected and Ha is accepted. It is concluded that there is a difference in student learning outcomes using learning media that do not use media that are used in the material for electrolyte solutions and non-electrolyte solutions for class X IPA.

Keywords: audiovisual learning media; project-based learning; chemistry

1. INTRODUCTION

In studying chemistry, students are faced with three worlds: the real world (macroscopic), the world of atoms (microscopic), and the world of symbols. One of the problems in learning chemistry is teaching students to understand the relationship between real life and molecular aspects, so technological media are needed. learning according to the needs of chemistry learning so that interaction activities between teachers and students achieve a predetermined goal. According to Suryani [1], the success of a learning process occurs when the goals set during the learning process have been achieved.

In this regard, the researchers developed a project-based learning audio-visual media learning model to increase the effectiveness of students in learning so they don't get bored and to improve student learning outcomes in chemistry class X SMA. One learning strategy that is considered to change abstractness in chemistry lessons is project-based learning. Project-based learning is learning that provides opportunities for teachers to manage learning by involving project work.

especially in the material "Chemical Bonds" at SMA Bina Bersaudara class X, students find it difficult to learn and understand the material, and as a result, many students get grades below the standard passing grade of 75 (seventy five). So researchers try to create a development model design entitled "Development of Project-Based Learning Audio-Visual Media in Chemistry Class X SMA", The development of the learning design is expected to attract students' interest in learning so that the learning process runs effectively and improves student learning outcomes in chemical bonding material.

1.1 The Nature of Learning and Learning Outcomes in Chemistry

Gagne and Briggs [2] define instruction or learning as a system that aims to help the student learning process and contains a series of events that are designed and arranged in such a way as to influence and support the internal student learning process. At first glance, the notion of teaching is almost the same as that of learning but is basically different. In learning, the conditions and situations that enable the learning process must be designed and considered in advance by the designer or teacher. Teaching and learning activities are the core activities of educational institutions. Many factors influence the achievement of positive learning outcomes, which are the result of the interaction between teaching activities, the learning environment provided by the school, and the skills, knowledge, attitudes, and behaviors of its students.

According to cognitive learning theory, learning is a change in perception and understanding. Kleden in Angkowo and Kosasih [3] argues that learning basically means practicing something, while learning something means knowing something. Cronbach gives the meaning of learning: "Learning is shown by a change in behavior as a result of experience." Harold Spears gives limitations on learning, namely: "Learning is to observe, to read, to imitate, to try something yourself, to listen, to follow directions, while Geoch said: "Learning is a change in performance as a result of practice" [4]. Historically, learning research has dealt primarily with the effects of three types of regularity in the environment: (1) regularity with the presence of one stimulus at different points in time, (2) regularity with the presence of two stimuli (both at the same time). in time, as in one-trial learning, and at various moments

in time; and (3) regularity in the presence of behavior and stimuli (also at a point in time and at different points in time).

Learning is a process that is carried out by providing education and training to students to achieve learning outcomes. Changes as a result of the learning process can be proposed in various forms, such as changes in knowledge, understanding, attitudes and behavior, skills, abilities, reaction power, receptiveness, and other aspects that exist in individuals who learn [5].

Meanwhile, according to other experts, "Learning is anything that can bring information and knowledge to the interactions that take place between educators and students" [6]. So it can be concluded that learning is a process that is carried out by providing education and everything that can bring information and knowledge to the interactions that take place between educators and students.

According to Rusmono [7], learning outcomes are changes in individual behavior that include the cognitive, affective, and psychomotor domains. This change in behavior is obtained after students complete their learning program through interaction with various learning resources and learning environments. "Learning outcomes are behaviors that can be observed and show one's abilities. According to Sudjana [8] "defining student learning outcomes is essentially a change in behavior as a result of learning in a broader sense, covering the cognitive, affective, and psychomotor fields"

1.2 Audio Visual Media-Based Learning

Learning media have an important role in supporting the quality of the teaching and learning process. Media can also make learning more interesting and fun. The learning medium that is currently being developed is audiovisual media. According to Benson, Florence Odera [9] The media is expected to play a critical role in enhancing academic performance. Media is expected to play an important role in increasing academic achievement.

Suranto [10] states that the media is a means used to convey messages from a communicator to a communicant. Gagne [11] argues that media are various types of components in a student's environment that can stimulate them to learn.

The benefits and functions of learning media, according to Kemp and Dayton in Prasetyo [12], suggest the benefits of using media in learning are: (1) the delivery of material can be uniform; (2) the learning process becomes clearer and more interesting; (3) the learning process becomes more interactive; (4) time and energy efficiency; (5) improving the quality of student learning outcomes; and (6) the media allows the learning process to be carried out anywhere and anytime. (7) The media can foster students' positive attitudes towards the material and the learning process; (8) The teacher's role can be changed in a more positive and productive direction. Audio-visual media in learning, Audio-visual media is a combination of audio and visual media that is self-created, such as slides combined with audio tapes [13].

According to Sanjaya [14], audio-visual media is media that has sound elements and image elements that can be seen, for example, video recordings, slides, sound, and so on. From the explanation of the experts above, it can be concluded that audio-visual media is a combination of audio and visual media that is self-created, such as slides combined with audio

cassettes, for example, video recordings, slides, sounds, and so on. Types of Audio-visual Media According to Syaiful Bahri Djamarah and Zain [15], audiovisual media is divided into two categories: (1) silent audio-visual, namely media that displays sounds and images such as sound frames (sound slides). (2) audio-visual motion, namely media that can display elements of sound and moving images, such as films and videos.

Advantages of Audio-visual Media, according to Atoel [16], states that audio-visual media has several advantages or uses, including: (1) clarifying the presentation of messages so that they are not too verbalistic (in the form of words, written or spoken). (2) overcoming the limitations of space, time, and sensory power, such as: objects that are too large being replaced with reality, images, film frames, films, or models. (3) Audio-visual media can play a role in tutorial learning. Arsyad [17] says that using learning media will attract more students' attention so that it can foster learning motivation. In learning activities, motivation can be said to be the overall driving force within students that creates, guarantees continuity, and provides direction for learning activities so that learning objectives can be achieved.

1.3 Project Based Learning (PjBL)-Based Learning in Chemistry Lessons

Project-based learning (PjBL) is an effective way to develop science process skills (KPS) and students' scientific literacy knowledge [18]. Therefore, the researcher chose PjBL as a learning model that will be developed in chemistry subjects so that students are effective in the learning process. The essence of project-based learning activities is to provide direct experience to students so that they can interpret symbols, theories, and the benefits of learning chemistry [19]. This needs to be done considering that the symbols and theories are abstract in nature.

Interest in something whose benefits are not known will be very small. If it weren't for the grades given by the teacher, students would not be interested in studying chemistry. It is necessary to direct students to be able to use chemistry in everyday life, find the meaning of chemistry in life, provide opportunities for students to be active in learning, and produce a product based on problems in the surrounding environment. Learning with PjBL (project-based learning), students design a problem and find their own solution.

Project-based learning has the advantage of its characteristics, namely helping students make decisions and frameworks, helping students design processes to determine an outcome, training students to be responsible for managing information carried out on a project that is carried out, and finally producing a real product of the student's results themselves, which are then presented in class and in real life.

Implementation of learning using the PjBL model will not work well if students have low achievement motivation [20]. Achievement motivation is the need to do well or strive for success, which is proven by persistence and effort in facing difficulties.

Project-based learning is a complex of activities based on challenging questions or problems that involve students in project design, problem solving, decision making, or investigative activities and give them the opportunity to work independently to produce original products [21]. Project-based

learning is an effective way to develop students' science process skills and scientific literacy knowledge [22]. The characteristics of the Project-Based Learning model include that students are faced with concrete problems, find solutions, and work on projects in teams to overcome these problems.

1.4 The Nature of Learning Media

According to Miarso [23], media is a tool that aims to provide stimulation for students so that the learning process runs optimally. Meanwhile, according to another opinion regarding the effectiveness of the media, Hamalik [24] emphasized that the media used by educators to convey information to students properly can affect the effectiveness of learning activities.

Furthermore, regarding Hamalik learning [25], learning is a combination composed of human elements (students and teachers), materials (books, blackboards, chalk, and learning tools), facilities (rooms, audio classes), and interrelated processes. affect achieving learning goals. From the explanation of the theory above, it can be concluded that learning media is a tool used by educators in a combination that is composed of human elements, materials, and learning facilities arranged to achieve learning objectives.

Media is a tool used by teachers and students to receive information and achieve learning goals. According to Kustandi and Sutjipto [26], "learning media is a tool that can help the teaching and learning process and serves to clarify the meaning of the message conveyed, so that it can achieve learning goals better and more perfectly". Various learning media can be used by teachers to convey learning material to students in a variety of ways so that it is not boring.

Kemp and Dayton [27], for example, identify several benefits of media in learning, namely: (1) the delivery of subject matter can be uniform; (2) the learning process becomes clearer and more interesting; (3) the learning process becomes more interactive; (4) Efficiency in time and effort; (5) Improving the quality of student learning outcomes; (6) Media allows the learning process to be carried out anywhere and anytime; (7) Media can foster a positive attitude towards learning materials and learning processes; (8) Media can change the role of the learner in a more positive and productive direction; (9) Media can make abstract subject matter more concrete; (10) Media can also overcome the limitations of space and time; and (11) Media can help overcome the limitations of the human senses.

The development of learning media using Adobe Flash CS4 software needs to be implemented in educational environments, especially for science lessons such as chemistry. Adobe Flash CS4 is an application that can be used to design and build presentation tools, publications, or other applications such as learning media. Daryanto [28] explained that the selection of learning media using Adobe Flash CS4 is appropriate and provides benefits for teachers and students. Using Adobe Flash Player, we must have Yahoo Mail, Facebook, and several other social media accounts for the linking process. Based on the opinion above, it can be concluded that Adobe Flash CS4 is software that can be used as a learning media design that benefits both teachers and students.
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Figure 1. Main display of chemistry learning media products using Adobe Flash CS4 software

The research problem is formulated as follows: (1) Is audio-visual media based on Project Based Learning assisted by the Adobe Flash CS4 application suitable for use in class X IPA electrolyte solutions and non-electrolyte solutions; and (2) Is the audio-visual media based on Project Based Learning assisted by the Adobe Flash CS4 application effectively used in the material for electrolyte solutions and non-electrolyte solutions for class X IPA SMA?

2. METHOD

The research model used is Research and Development or Research and Development (R&D). Sukmadinata [29] states that the research and development (R&D) method is a strategy or research method that is powerful enough to improve practice. The research method used in this study refers to the research and development model presented by Borg and Gall [30]. According to Borg and Gall [31], research and development in education is based on industrial research and development models, where research results are used to design new products and procedures that are then field tested systematically, evaluated, and refined until they meet specific criteria, namely effectiveness, quality, and standards.

This research will be conducted at the Bina Bersaudara Private High School, Kec.Selesai, which is located on Jalan Jamin Ginting, Kuta Parit, Kec. Done Langkat Regency. Class X IPA I and Class X IPA II for the 2022–2023 academic year The subjects in this study were students of class X SMA IPA, which consisted of two classes, namely: first-class students in class X IPA I, totaling 40 students, and second-class students in class X IPA II, totaling 32 students. The object of this study is the subject of chemistry on chemical bonding competition material in the form of audio-visual media with the help of project-based learning-based Adobe Flash CS4.

This research model refers to the Borg & Gall model with slight adjustments according to the research context of the 10 steps, namely: first, research and information gathering; second, planning; third, preliminary product development; fourth, initial field testing; fifth, revision of the first product; sixth, main field trial; seventh, operational product revision; eighth, operational field trial; ninth, final product revision; tenth, dissemination and distribution.

 a feasibility test on project-based learning audio-visual media to improve student learning outcomes in class X, SMA Bina Bersaudara Kec. Completed, in the form of material experts, instructional media experts, and instructional designers with the appropriate criteria in Table 1 below:

Table 1. Feasibility Interpretation

Intervals	Interpretation	
0.00 – 2.49	Not Good	Not feasible
2.50 – 3.32	Less Good	Less Eligible
3.33 – 4.16	Good	Eligible
4.17 – 5.00	Very Good	Very Eligible

(Source: Sriadhi [32])

his research was said to be successful if the results obtained from the questionnaire met the criteria of "Very Good" or "Very Eligible" and "Good" or "Decent" with a score interval of 3.33-5.00.

The practicality of the learning model developed in this study was measured using a questionnaire assessing the use of the learning model in the learning process. The practicality value can be calculated using the formula in Table 2 below:

Table 2. Criteria for the Practicality of the Learning Model

Score Intervals	Criteria
3,5 – 4,00	Very Practical
3,00 – 3,49	Practically Without Repair
2,50 – 2,99	Practically Needs Improvement
2,00 – 2,49	Less Practical
1,00 – 1,99	Impractical

The effectiveness of the learning model developed depends on having two types of data, namely qualitative and quantitative. Qualitative data is generated from preliminary or feasibility studies, either in literature studies or field studies. Quantitative data were obtained from student learning outcomes using quasi-experiments, namely comparing pre-test and post-test scores of students using audio-visual media with the help of Adobe Flash CS4 based on the developed project-based learning. In this study, the data obtained were student learning outcomes from the experimental and control classes with the assessment criteria as seen in Table 3 below:

Table 3. Assessment Criteria

Value	Criterion	Percentage (%)
A	Very Good	81-100%
B	Good	61-80%
C	Enough	41-60%
D	Less Good	21-40%
E	Very Poor	0-20%

Data collection was carried out using a questionnaire by distributing questionnaires to the respondents, namely material experts, media experts, design experts, and students. The respondents gave an assessment of the quality of the audio-visual media with the help of Adobe Flash CS4 based on project-based learning with the following research criteria:

Table 4. Scoring Rules

No	Category	Score
1	Very Good	5
2	Good	4
3	Enough	3
4	Less Good	2
5	Very Poor	1

(Source: Arikunto, [33])

The research results of each respondent were used to calculate the average score obtained. The average score obtained is then converted into a qualitative value using the formula and basic guidelines to determine the level of validity as follows:

$$P = \frac{\sum x}{\sum x^1} \times 100\%$$

Information:
P = Large Percentage
$\sum x$ = Number of Validator Answer Scores
$\sum x^1$ = Total Highest Answer Score

Table 5. Product Validation Criteria

Percentage %	Validity Level	Information
80 – 100	Very valid	Not Revised
60 – 79	Valid	Not Revised
40 – 59	Invalid	Some Revisions
20 – 39	Invalid	Revision
0 - 19	Very invalid	Revision

(Source: Arikunto [34])

Analisis Data Efektivitas media audio visual dengan bantuan *Adobe Flash CS4* berbasis *Project Based Learning*

Normality test.
To determine the average value, the formula is used, namely:

$$\bar{x} = \frac{\sum f_i \, x_i}{\sum f_i}$$

To calculate the standard deviation (s), the formula is used, namely:

$$s = \sqrt{\frac{n\sum x_i^2 - \left(\sum x_i\right)^2}{n(n-1)}}$$

By testing criteria:
If Lo < Lt then the sample is normally distributed and if Lo > Lt then the sample is not normally distributed

Homogeneity Test.
Examination of the variance homogeneity test aims to determine whether the sample data has a homogeneous variance or not. Test the homogeneity of variance using the F test, with the following hypotheses:

$H_0 : \sigma_1^2 = \sigma_2^2$ the two populations have the same variance..

$H_a : \sigma_1^2 \neq \sigma_2^2$ the two populations have different variances

$F_{hit} = \frac{\text{var}ians\ terbesar}{\text{var}ians\ terkecil}$

Kriteria Pengujian adalah :
F_{hit} < $F_{tab1/2\ \alpha(v1, v2)}$, Ho accepted
F_{hit} > $F_{tab1/2\ \alpha(v1, v2)}$, Ho is rejected

Data processing shows that Fcount < Ftable, then H0 is accepted. It can be concluded that the two samples have a homogeneous variance. If data processing shows that Fcount > Ftable, then H0 is rejected and Ha is accepted, it can be concluded that the two samples do not have a homogeneous variance..

Research Hypothesis Test.

Testing the hypothesis in this study was carried out using the one-party t-test formula where the statistical hypothesis being tested can be formulated as follows:

H$_a$: There are differences in the learning outcomes of students who study by using audio-visual media with the help of Adobe Flash CS4 based on Project Based Learning and students who learn by not using learning media.

H$_0$: There is no difference in the learning outcomes of students who study using audio-visual media with the help of Adobe Flash CS4 based on Project Based Learning and students who study without using learning media.

To find out the significant differences of student learning outcomes. The t test formula is as follows:

$$t = \frac{\overline{X}_1 - \overline{X}_2}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

The test criteria are that Ha is accepted if tcount < ttable and Ho is rejected if tcount > ttable, which is obtained from the t distribution list with dk = (n - 1) and level α = 5%. To see the value of the effectiveness of audio-visual media with the help of Adobe Flash CS4 based on project-based learning that is being experimented on, the effectiveness calculation formula is used as follows:

$$X = \frac{\text{number of students who completed}}{\text{total number of students}} \times 100\%$$

3. RESULTS AND DISCUSSION
3.1 RESULTS

ssessment results by Validation of Linguists; Material Expert Validation; Learning Design Validation; Small Group Trial; Large Group Trial for all aspects of the assessment is determined by the average score. The results of the assessment are then analyzed and determined whether or not it is appropriate to develop audio visual media with the help of Adobe Flash CS4 based on Project Based Learning. The average percentage of the results of the assessment is in Table 6 below:

Table 6. Feasibility of audio visual media with the help of Adobe Flash CS4 based on Project Based Learning

No	Categorization	Percentage of average score%	Criteria
1.	Material Expert Validation	80,00	Is very feasible
2.	Media Expert Validation	90,00	Is very feasible
3.	Learning Design Validation	80,00	Is very feasible
4.	Preliminary Field Test	89,00	Is very feasible
5.	Main Trial	89,70	Is very feasible
6.	Operational Trial	87,00	Is very feasible
Average		85,95	Is very feasible

Based on Table 6 it can be concluded that the scoring intervals for material expert validation, media expert validation, learning design validation, initial field trials, main trials, and operational trials show an average of 85.95 with very feasible criteria. So

the application of audio visual media with the help of Adobe Flash CS4 based on Project Based Learning is very feasible.

Data normality checks are used to determine whether the sample comes from a normally distributed population. The test was carried out using the Liliefors test on two sample groups. A summary of the data normality test can be seen in Table 7 below:

Table 7. Summary of Data Normality Test

No	Class	L count	L table	Conclusion
1	Student learning outcomes are taught using audio-visual media with the help of Adobe Flash CS4 based on Project Based Learning	0,12	0.15	Normal
2	Student learning outcomes are taught by not using audio visual media with the help of Adobe Flash CS4 based on Project Based Learning	0,14	0.15	Normal

In the table above, it is found that the data on student learning outcomes taught using audio-visual media with the help of Adobe Flash CS4 based on Project Based Learning is normally distributed. This is known from the large Lcount <Ltable at a significant level of 5%, namely 0.12 <0.15. Data on learning outcomes taught using audio-visual media with the help of Adobe Flash CS4 based on Project Based Learning is normally distributed. This is known from the large Lcount <Ltable at a significant level of 5%, namely 0.14 <0.15.

To test the homogeneity of the research data, Fisher's test was used. Based on the calculation of homogeneity, it is obtained that the data on student learning outcomes that are taught using audio-visual media with the help of Adobe Flash CS4 based on Project Based Learning is homogeneous. It is known from the Fcount <Ftable at a significant level of 5%, namely Fcount (1.42) <Ftable (1.80). Data on student learning outcomes taught using audio-visual media with the help of Adobe Flash CS4 based on Project Based Learning is homogeneous. It is known from the Fcount <Ftable at a significant level of 5%, namely Fcount (1.25) <Ftable (1.80). A summary of the homogeneity test can be seen in Table 8 below:

Table 8. Summary of Data Homogeneity Test

No	Class	F count	F table	Conclusion
1	Student learning outcomes are taught using audio-visual media with the help of Adobe Flash CS4 based on Project Based Learning	(1,42)	(1,80)	Homogeneous

2	Student learning outcomes are taught by not using audio visual media with the help of Adobe Flash CS4 based on Project Based Learning	(1,25)	(1,80)	Homogeneous

Student Learning Outcomes Using audio-visual media with the help of Adobe Flash CS4-based Project Based Learning in Chemistry Subjects are Higher Than Learning Outcomes Using conventional Learning Models. Testing the hypothesis used is a different test. From the calculation results obtained tcount = 2.14 while ttable = 1.66. Because tcount = 2.14 > ttable = 1.66, it can be concluded that the learning outcomes of students who use audio-visual media with the help of Adobe Flash CS4 based on Project Based Learning are higher than the learning outcomes of students who do not use media. Summary of hypothesis testing can be seen in Table 9 below:

Table 9 Summary of Hypothesis Test Calculations

Average Posttest Value		T_{count}	t_{table}	Conclusion
Using audio visual media with the help of Adobe Flash CS4 based on Project Based Learning	Not using audio visual media with the help of Adobe Flash CS4 based on Project Based Learning	2,14	1,66	There is a significant difference
72,60%	65,33%			

From the results of hypothesis testing, empirical evidence is obtained that student learning outcomes using audio-visual media with the help of Adobe Flash CS4 based on Project Based Learning are higher than student learning outcomes using conventional learning models.

The effectiveness of the inolyn learning model based on blended learning in the basics of beauty and SPA subjects is as follows:
x = (Total score obtained)/(Total ideal score) x 100%
x = 2396/3300 x 100% = 71.58%

While the effectiveness of learning by using conventional learning models.

x = (Total score obtained)/(Total ideal score) x 100%
x = 2156/3300 x 100% = 66.35%

Thus the value of the effectiveness of audio-visual media with the help of Adobe Flash CS4 based on Project Based Learning in the basics of beauty and SPA subjects is higher than not using learning media

3.2 DISCUSSION
The results of the study show that learning media play an important role in supporting the quality of the teaching and learning process. Media can also make learning more interesting and fun. The learning medium that is currently being developed is audiovisual media. According to Ambuko Benson and Florence Odera [35], The media is expected to play a critical role in enhancing academic performance. Media is expected to play an important role in increasing academic achievement. Suranto [36] states that the media is a means used to convey messages from a communicator to a communicant. Gagne [37] argued that the media are various types of components in the student's environment that can stimulate them to learn.

In line with the media functions developed for chemistry learning videos supported by the benefits and functions of Learning media, according to Kemp and Dayton in Prasetyo [38], the benefits of using media in learning are: (1) the delivery of material can be uniform; (2) The learning process becomes clearer and more interesting; (3) the learning process becomes more interactive; (4) time and energy efficiency; (5) the quality of student learning outcomes; and (6) the media allows the learning process to be carried out anywhere and anytime. (7) The media can foster students' positive attitudes towards the material and the learning process; (8) The teacher's role can be changed in a more positive and productive direction.

The chemical audio-visual media developed is said to be feasible and has met several stages of expert validation as well as trials on students, with several things declared feasible because they are supported by the advantages of the Audio-visual media. According to Atoel [39], audio-visual media has several advantages or uses, including: (1) clarifying the presentation of the message so that it is not too verbalistic (in the form of words, written or spoken). (2) overcoming the limitations of space, time, and sensory power, such as objects that are too large being replaced with reality, images, film frames, films, or models. (3) Audio-visual media can play a role in tutorial learning. Arsyad [40] says that using learning media will attract more students' attention so that it can foster learning motivation. In learning activities, motivation can be said to be the overall driving force within students that creates, guarantees continuity, and provides direction for learning activities so that learning objectives can be achieved.

Supported by the same research by Raum Syahputri with the research title Quality of PjBL-based chemical teaching materials on the subject matter of electrolyte and non-electrolyte solutions. The results of the research were obtained from 126 due diligence interviews with media experts, material experts, PjBL experts, and students' responses to teaching materials. After the feasibility test was carried out by the expert validator and the responses of the students obtained an average value of 84.05% in the very feasible category, it can be continued to the large class implementation stage. The results of the project assessment, which include process aspects, product aspects, and students' attitude aspects, obtained an average of 80.74. The results of students' assessments of teaching materials obtained a percentage of 82.32% in the proper category.

The same thing was explained about the results of research by Muliaman [41] with the research title The Effectiveness of the Project-Based Learning Model Oriented on eXe Learning and Motivation on Learning Outcomes in Reaction Rate Material. The results showed that there were differences in improving learning outcomes through the eXe-Learning-oriented PjBL model and Macromedia Flash-oriented Direct Instruction at high and low motivation levels. Learning in the experimental

class using the eXe-Learning oriented PjBL model obtained better results with an average N-gain of 0.73, while the average N-gain of the control class was 0.63, so a more effective eXe-Learning oriented PjBL model was obtained. used in learning Reaction Rate.

4. CONCLUSION

Based on the results of the analysis and discussion of the data, it can be concluded, namely:
1. Project-based learning-based audio-visual media assisted by the Adobe Flash CS4 application has been tested to obtain a percentage value of 85.95% with the criteria of "very feasible" to be used in the material for electrolyte solutions and non-electrolyte solutions for class X IPA SMA Bina Bersaudara.
2. Audio-visual media based on project-based learning assisted by the Adobe Flash CS4 application that has been tested has obtained a score of 95% with the criteria of "effective" and obtained tcount = 2.14 > ttable = 1.66 so that Ho is rejected and Ha is accepted, it is concluded that there is a difference in the results of student learning using learning media with those that do not use media used in the material for electrolyte solutions and non-electrolyte solutions for class X IPA SMA Bina Bersaudara

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Interactive Multimedia-Based Learning Media: Improving Mandarin Learning Outcomes

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Abstract: This research is motivated by the lack of variety in learning media and low learning outcomes in Mandarin subjects. The purpose of this study was to produce appropriate and effective interactive multimedia-based learning media for improving student learning outcomes at SMA Santo Thomas 1 Medan. The type of research used is the development model of Borg and Gall. The research instruments used were initial needs questionnaires, material expert validation questionnaires, media expert questionnaires, and student response questionnaires. This study also uses quantitative data analysis techniques (data on the feasibility and effectiveness questionnaire assessment) and qualitative data (observation data and documentation). Product validation results show a score percentage of 88.23% for material expert validation, 89.41% for media expert validation, 90% for design expert validation, and 94.31% for student responses. The results of the normality and homogeneity tests show that the research data has been declared normal and homogeneous. The results of the hypothesis test show that the value of t count is 1.89 and the value of t table is 1.66, where t count > t table. The results of this study indicate that this interactive multimedia-based learning medium is effective in improving student learning outcomes at SMA Santo Thomas 1 Medan.

Keywords: learning media, interactive multimedia, Mandarin

1. INTRODUCTION

Mandarin is a foreign language that is difficult to learn and understand. So learning Mandarin is not enough to read and memorize exact subjects but also requires a strong understanding of the basic material of Mandarin [1]. This is because the delivery of basic Chinese material requires audio as a demonstration of examples of pronunciation in Mandarin, especially in phonetic material and tones. Meanwhile, in the stroke material, an animated display is needed to display the direction of strokes in Chinese characters. In other words, learning Mandarin using learning methods without assistive media is less effective when applied to Mandarin subjects.

Language has a very important role in human life. Language is a communication tool in the form of a sound symbol system and is used as a unifying tool for humans. Language is a verbal tool used to communicate. Aside from being a means of communication, language also acts as a means of showing self-identity. Through language, everyone can show their point of view, understanding of something, the origin of their nation and country, education, and even a person's character.

Mandarin is one of the local content subjects that is mandatory for students from class X to class XII at SMA Santo Thomas 1 Medan. The material taught starts at elementary, intermediate, and advanced levels, so the delivery of basic Mandarin introduction teaching materials must really be absorbed and understood by students. Based on observations at SMA Santo Thomas 1 Medan, researchers found problems experienced by students, namely: (1) students still had difficulty mastering Chinese vocabulary and writing sentences in Mandarin; (2) not all students had smartphone applications that made it easier to learn languages like Mandarin; (3) when the teacher teaches, some students are still not paying attention and many are still chatting alone, sleepy, and some are not paying attention; (4)

when given homework, students often do not work on it; and (5) students are more active and enthusiastic when learning nuanced games.

Changes and shifts in the educational paradigm because learning in schools has begun to be adapted to developments in information technology through the use of learning media. Media development is expected to assist students in improving learning outcomes by utilizing the media. Utilization of media such as interactive multimedia is a solution to making it easier for students to learn the material [3]. Interactive multimedia is a medium consisting of images, sounds, and video materials that are presented under computer control for students so that they not only see images and hear sounds but also make active responses. This response affects the speed and sequence of the presentation of learning material [4].

The use of interactive media is more effective in improving student learning outcomes. Interactive learning media can significantly increase students' interest and reading activity. In addition, learning media can also provide positive stimulation for students' curiosity to learn more deeply [5]. Interactive media has been declared effective and can help students in the process of learning Mandarin [6]. However, until now, no one has published a test of interactive multimedia-based learning media to improve Mandarin learning outcomes in the competency of carrying out conversations by asking people during celebrations.

1.1 The Nature of Learning and Learning Outcomes of Mandarin

According to Smith and Ragan [7], interpreting the concept of learning as a relatively permanent change in one's knowledge and behavior resulting from experience Furthermore, Smith and Ragan [8] suggest three important factors that mark the

occurrence of learning events in individuals, namely: (1) the duration of a relatively permanent change in behavior; (2) the locus or place of change in the knowledge structure and memory of the learner; and (3) the cause of the change is the experience factor contained in the environment.

According to Gagne [9], learning is a set of internal processes for each individual as a result of the transformation of stimuli originating from external events in the individual's environment (conditions). In order for the external conditions to be more meaningful, they should be organized in a sequence of learning events (method or treatment). In addition, in an effort to regulate external conditions, various stimuli that can be received by the five senses are needed, which are known as media and learning resources [10].

Furthermore, Gagne & Briggs [11] explained that learning is the result of pairs of stimuli and responses that are then continuously reinforced. This reinforcement is intended to strengthen the behavior that is internalized in the learning process. Each person's learning process will produce different learning outcomes, so it needs continuous reinforcement to experience changes in behavior for the better.

Learning is a translation of the word instruction," which in Greek is called instructus or intruere," which means conveying thoughts; thus, the meaning of instructional is conveying thoughts or ideas that have been processed in a meaningful way through learning [12]. The word learning contains a meaning that is more pro-active in carrying out learning activities because, in it, it is not only educators or instructors who are active, but students are active subjects in learning [13].

In the process of learning and acquiring language, there are several skills that must be mastered by students. According to Tarigan [14], language skills have four components: (1) listening skills; (2) speaking skills; (3) reading skills (reading skills); and (4) writing skills (writing skills). Writing is a skill that is more complex than other skills. Writing is used as indirect communication.

Mandarin is a language that uses pictograph writing, namely letters derived from images or symbols used in ancient times [15], so special skills are needed to write vocabulary and sentences in Mandarin. This is what often makes learning Mandarin very difficult in Indonesia. The basic competencies of learning materials in research can be seen in Table 1 below:

Table 1. Basic Material Competency

Basic competencies	Achievement Indicator	Learning objectives	Learning Material Topics
Have a conversation by asking someone in celebration	Demonstrates how to write mandarin characters	Students can write Mandari characters	庆祝 (celebrate) 建议 (suggestion) 开 (open, hold) 晚会 (party)

1.2 The Nature of Learning Media

According to Gagne [16], media are various types of components in the student environment that can provide stimulation for learning. According to Heinich [17], the media

is a communication channel tool that delivers information between message sources and message recipients. Exemplified by Heinich, these media include television, films, printed materials, diagrams, instructors, and computers. If these media carry messages to achieve learning objectives, then they can be considered learning media. Heinich also connects the media with methods and messages.

Learning media are all forms of communication tools that can be used to convey information from sources to students in a planned manner so as to create a conducive learning environment where recipients can carry out the learning process efficiently and effectively [18]. Learning media is a channel or intermediary that can be used to convey messages (learning materials) so that it can stimulate the attention, interest, thoughts, and feelings of learners (students) in learning activities to achieve certain learning goals. Learning media is a means of communication in print as well as sight and hearing, including hardware technology [19].

Hamzah [20] suggests that the use of learning media in the learning process can generate new desires and interests, generate motivation and stimulate learning activities, and even have psychological influences on students. Levie and Lentz [21] suggest four functions of learning media, especially visual media, namely: (1) The attentional function of visual media is the core, namely attracting and directing students' attention to concentrate on lessons related to the meaning displayed or accompanying the text of the subject matter; (2) The affective function of visual media can be seen from the enjoyment of students when learning (or reading) pictorial texts; (3) The cognitive function of visual media can be seen from research findings which reveal that visual symbols or images facilitate the attainment of the goal of understanding and remembering or the message contained in the image; and (4) The compensatory function of learning media can be seen from the results of research that visual media that provide context for understanding texts helps students who are weak in reading to organize information in texts and recall them.

1.3 The Nature of Interactive Learning Multimedia

According to Sanaky [22], multimedia in the learning process is the use of various types of media together, such as text, video, images, and others, with all media uniting to achieve the learning objectives that have been formulated. Based on the definitions given by several experts, it can be concluded that multimedia is a combination of various kinds of interactive text, audio, graphic, animation, and video media that will be delivered using a computer or electronic equipment to convey information and can be used to assist the learning process.

According to Munir [23], interactive multimedia is multimedia that is made with a display that fulfills the function of conveying information or messages and has interactivity for its users. While learning multimedia is the application of multimedia use in the learning process, it can be said that in the process of communication or channeling messages, the use of various media is used to stimulate students to pay attention and have the will so that the learning process can occur.

According to Surjono [24], interactive learning multimedia is a learning program that combines text, images, videos, animations, etc. with the help of a computer to achieve learning objectives, and users can actively interact with the program. According to Munir [25], multimedia is the use of various kinds

of media, such as text, graphics, sound, animation, and video, which are then coupled with interactive components to convey information.

Learning media must consider design quality as a technical aspect, the four goals of visual design or screen design are very good from Heinich [26], namely: readability aspects, the effort required to interpret the message conveyed must be reduced, the user's active involvement with the message conveyed must be enhanced, and the user's attention is focused on the most important parts of the message.

According to Sutopo [27], to make a good visual design, it must also include clear visuals, consistency, aesthetics, and download speed. Heinich [28] provides advice that when making verbal or visual displays, it is best to pay attention to visual principles, namely the elements (visual and verbal), pattern (pattern), and arrangement (arrangement). The visual and verbal components referred to include: letter style, number of lettering styles, capitals, color of lettering, size of lettering, and spacing between lines. Elements that can add to the attraction include surprise, texture, and interaction. Patterns include equipment, shape, balance, style, scheme, color, and color appeal. Meanwhile, what includes the arrangement is the scale of proximity (proximity), direction (directionals), contrast of the image with the background, and combinations.

According to Nielsen [29], there are three aspects of learning media assessment, namely aspects of interface design, aspects of instructional design, and aspects of content: (1) Interface Design Aspects: a) Visibility of information to the user about what is going on when needed through feedback; b) Natural and logical Based on the facts, the language used is a natural and logical analogy; c) Control Users can use the control to exit the display, and errors can be undone. d) Stable consistency and general standard; e) Prevent errors Errors by users can be prevented. f) Easily identifiable Information can be understood easily and accessed at any time; g) Flexible and efficient Shortcuts are easy for users to use. h) Aesthetic and simple The application is attractive, and the information is relevant. i) Error messages Users can diagnose and fix errors. Error messages are

displayed in easy-to-understand language, and there are recommended solutions. j) Help and documentation Availability of easily accessible online help and documentation; (2) Instructional Design Aspects: a) Goals and Objectives Clear goals and objectives, so that users can easily understand; b) context based on the educational domain; c) Content and navigation of single meaningful information, clear and unambiguous; d) Scaffolding Students can learn material according to their level of knowledge. Students must be able to understand the material conceptually. f) Formative evaluation Students must be able to provide feedback. g) Criteria-referenced The results of the application must be clear and measurable so that they can be evaluated. h) Independent learning Applications help students learn without the help of others. i) Collaborative learning Applications must support interaction with others. (3) Content Aspect: a) Context Must be based on facts; b) Realistic Relevance and Relevance; c) Issue There is an alternative solution to the problem. d) References There are references: e) Videos Videos must be accessible. f) Assistance There is assistance that makes it easier for users; g) Presentation Presentation of interesting material.

The development of interactive learning media requires applications in the form of programming that can be designed according to user needs. Among the many pieces of software that are often used to create animation is Macromedia Flash. Macromedia Flash is a web animation graphics program produced by MCorp.media Corp, which is a software vendor engaged in web animation. At the start of production, the program was software for creating simple GIF-based animations [30]. Macromedia Flash has several versions, one of which is Macromedia Flash 8.

Macromedia Flash 8 is used to process images, animations, imported bitmap images, and sound objects. Besides that, it can be used for the development of learning media because it can display interesting text, images, and animations simultaneously [31]. According to Sucipta [32], there are several advantages to making learning media using Macromedia Flash Professional 8.

Figure 1. Display of interactive multimedia-based learning media in Mandarin

The research problem is formulated as follows: (1) Is the developed interactive multimedia-based learning media suitable for use in Mandarin language skills in class XI SMA Santo Thomas 1 Medan? and (2) Is the developed interactive multimedia-based learning media effectively used to improve

learning outcomes in Mandarin in class XI SMA Santo Thomas 1 Medan?

2. METHOD

This type of research is a type of development research, commonly called development (Research and Development). Research development is research that aims to produce a product through the development process [33].
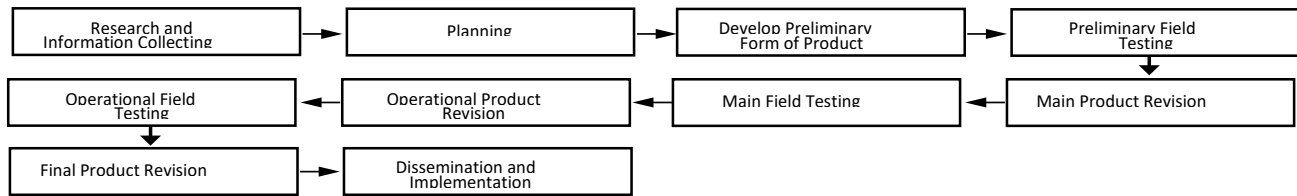
According to Borg and Gall [34], development research is a process used to develop and validate products. The purpose of development research is not only to develop products, but more than that, to find new knowledge or answer specific questions about practical problems (through applied research).

Figure 2. Borg and Gall Procedure (Source: Borg & Gall, 1983: 775)

This research was conducted at SMA Santo Thomas 1 Medan, which is located at Jalan S Parman No. 109 Medan, for class XI students in the 2022–2023 academic year. The subjects of this study were students in class XI at SMA Santo Thomas 1 Medan. As for class X IPS 1 as the experimental class and class X IPS 2 as the control class, The selection of subjects in this study used a purposive sampling technique, namely the determination of the research sample based on the considerations of the researcher, who considered that the desired research elements already existed in the members of the sample taken and based on suggestions from the Chinese language study teacher at school.

The practicality of the learning model developed in this study was measured using a questionnaire assessing its use in the learning process. The practicality value can be calculated using the formula in Table 3 below:

Table 3. Criteria for the Practicality of the Learning Model

Score Interval	Criterion
3,5 – 4,00	Very Practical
3,00 – 3,49	Practically Without Repair
2,50 – 2,99	Practically Needs Improvement
2,00 – 2,49	Less Practical
1,00 – 1,99	Impractical

The effectiveness of the learning model developed depends on having two types of data, namely qualitative and quantitative. Qualitative data is generated from preliminary or feasibility studies, either in literature studies or field studies. Quantitative data were obtained from student learning outcomes using quasi-experiments, namely comparing the pre-test and post-test scores of students using interactive multimedia-based learning media. In this study, the data obtained were student learning outcomes from the experimental and control classes with the assessment criteria as seen in Table 4 below:

Table 4. Assessment Criteria

Value	Criteria	Percentage (%)
A	Very Good	81-100%
B	Good	61-80%
C	Enough	41-60%
D	Less Good	21-40%
E	Very Poor	0-20%

Data collection was carried out using a questionnaire by distributing questionnaires to the respondents, namely material experts, media experts, design experts, and students. The respondents gave an assessment of the quality of interactive multimedia-based learning media with the following research criteria:

Table 5. Scoring Rules

No	Category	Score
1	Very good	5
2	Good	4
3	Pretty good	3
4	Not good	2
5	Not good	1

(Source: Arikunto [35])

The research results of each respondent were used to calculate the average score obtained. The average score obtained is then converted into a qualitative value using the formula and basic guidelines to determine the level of validity as follows:

$$P = \frac{\sum x}{\sum x^1} \times 100\%$$

Information:
P = Large Percentage
$\sum x$ = Number of Validator Answer Scores
$\sum x^1$ = Total Highest Answer Score

Table 6. Product Validation Criteria

Percentage %	Validity Level	Information
80 – 100	Very valid	Not Revised
60 – 79	Valid	Not Revised
40 – 59	Invalid	Some Revisions
20 – 39	Invalid	Revision
0 - 19	Very invalid	Revision

(Source: Arikunto [36])

Data analysis of the effectiveness of interactive multimedia-based learning media

Normality test.
To determine the average value, the formula is used, namely:

$$\bar{x} = \frac{\sum f_i \, x_i}{\sum f_i}$$

To calculate the standard deviation (s), the formula is used, namely:

$$s = \sqrt{\frac{n \sum x_i^2 - \left(\sum x_i\right)^2}{n(n-1)}}$$

By testing criteria:

If $L_0 <$ L hen the sample is normally distributed and if $L_0 >$ L then the sample is not normally distributed

Homogeneity Test.

Examination of the variance homogeneity test aims to determine whether the sample data has a homogeneous variance or not. Test the homogeneity of variance using the F test, with the following hypotheses:

$H_0 : \sigma_1{}^2 = \sigma_2{}^2$ the two populations have the same variance.

$H_a : \sigma_1{}^2 \neq \sigma_2{}^2$ the two populations have different variances.

To test the hypothesis above, the following formula is used:

$$F_{hit} = \frac{\text{var}ians\ terbesar}{\text{var}ians\ terkecil}$$

Test Criteria are:

$F_{hit} < F_{tab1/2\ \alpha(v1, v2)}$, H_0 accepted

$F_{hit} > F_{tab1/2\ \alpha(v1, v2)}$, H_0 is rejected

Under the condition:
real level $\alpha = 0,05$
$v_1 = n_1 - 1$ dan n_1 = size of the largest variance
$v_2 = n_2 - 1$ dan n_2 = smallest variance size

Data processing shows that if Fcount < Ftable, then H0 is accepted. It can be concluded that the two samples have a homogeneous variance. If data processing shows that Fcount > Ftable, then H0 is rejected and Ha is accepted, then it can be concluded that the two samples do not have a homogeneous variance.

Research Hypothesis Test Testing the hypothesis in this study was carried out using the one-party t-test formula, where the statistical hypothesis being tested can be formulated as follows:

H_a: There are differences in the learning outcomes of students who study using interactive multimedia-based learning media and students who study with printed books.

H_0: There is no difference in the learning outcomes of students who study using interactive multimedia-based learning media and students who study with printed books.

To find out if there are significant differences in student learning outcomes, the t-test formula is as follows:

$$t = \frac{\overline{X}_1 - \overline{X}_2}{s\sqrt{\dfrac{1}{n_1} + \dfrac{1}{n_2}}}$$

Where S is the combined variance calculated by the formula:

$$S^2 = \frac{(n_1 - 1)S_1{}^2 + (n_2 - 1)S_2{}^2}{n_1 + n_2 - 2}$$

Information::
t   = calculated t value obtained
$\overline{X}_1$ = Average score of the experimental class sample
$\overline{X}_2$ = Average score of the control class sample
n_1 = the number of subjects in the experimental group
n_2 = number of control group subjects
S_1^2 = standard deviation of the experimental group
S_2^2 = standard deviation of the control group
S   = combined variance

The test criteria are that Ha is accepted if tcount < ttable and Ho is rejected if tcount > ttable, which is obtained from the t distribution list with dk = (n - 1) and level $\alpha = 0.05$. To see the value of the effectiveness of interactive multimedia-based learning media that is being experimented with, the effectiveness calculation formula is used as follows:

$$X = \frac{\text{number of students who completed}}{\text{total number of students}} \times 100\%$$

3. RESULTS AND DISCUSSION
3.1 RESULTS

The results of the assessment by media experts, material experts, individual trials, small group trials, and limited field trials for all aspects of the assessment are determined by the average score. The results of the assessment are then analyzed and determined to determine whether or not it is appropriate to develop interactive multimedia-based learning media. The average percentage of the results of the assessment of media experts, material experts, individual trials, small group trials, and field trials is shown in Table 7 below:

Table 7. Feasibility of interactive multimedia-based learning media

No	Categorization	Percentage of average score%	Criteria
1.	Material Expert Validation	88,23	Is very feasible
2.	Media Expert Validation	89,41	Is very feasible
3.	Learning Design Validation	90,00	Is very feasible
4.	Preliminary Field Test	90,00	Is very feasible
5.	Main Trial	93,80	Is very feasible
6.	Operational Trial	94,31	Is very feasible
Average		90,96	Is very feasible

Based on Table 7, it can be concluded that the scoring intervals for material expert validation, media expert validation, learning design validation, initial field trials, main trials, and operational trials show an average of 4.56 with very feasible criteria. So the application of interactive multimedia-based learning media is very feasible and appropriate for learning.

Based on the learning outcomes of students who were taught using interactive multimedia-based learning media, the lowest score was 70 and the highest score was 98. The average score was 84,313, mode 83, median 84, and standard deviation 7.601. To see student scores, an interval class is used, namely the score between absolute frequency (the number of students who have learning achievement scores) and relative frequency (the number of percent of learning achievement scores). A complete description of learning outcomes using interactive multimedia-based learning media is shown in Table 8.

Table 8. Frequency Distribution of Experiment Class Student Learning Outcomes

Class	Interval Class	Absolute Frequency	Relative Frequency
1	70 – 74	4	12,5%
2	75 - 79	3	9,375%
3	80 - 84	10	31,25%
4	85 - 89	8	25%
5	90 - 94	3	9,375%

| 6 | 95 - 99 | 4 | 12,5% |
| Total | | 32 | 100% |

Based on the learning outcomes of students who were taught using textbooks at SMA Santo Thomas 1 Medan, the lowest score was 70 and the highest score was 96. The mean score was 80,813, mode 75, median 81.5, and standard deviation 7.195. A complete description of learning outcomes using printed books is shown in Table 9.

Table 9 Frequency Distribution of Control Class Student Learning Outcomes

Class	Interval Class	Absolute Frequency	Relative Frequency
1	70 - 74	5	15,625%
2	75 - 79	6	18,75%
3	80 - 84	11	34,375%
4	85 - 89	6	18,75%
5	90 - 94	2	6,25%
6	95 - 99	2	6,25%
Total		32	100%

The data normality test uses the Liliefors test with the null hypothesis (H0), which states that the sample comes from a normally distributed population. Acceptance and rejection (H0) are based on a comparison of the price of Lcount with the price of Ltable at a significant level α = 0.05. If Lcount < Ltable, then the data is normally distributed. A summary of data normality test results in the experimental class and control class can be seen in Table 10.

Table 10. Summary of the Data Normality Test with the Liliefors Test

No.	Data	No	Class	L count	L table
1	Pretest	Experiment	0,083	0,157	Normal
2	Pretest	Control	0,069	0,157	Normal
3	Posttest	Experiment	0,119	0,157	Normal
4	Posttest	Control	0,088	0,157	Normal

Based on table 10, it can be seen that the results of the pretest data normality test in the experimental class obtained Lcount < Ltable (0.083 <0.157) and in the control class also obtained Lcount <Ltable (0.069 <0.157). The same thing also happened to the posttest data normality test results for the experimental class with Lcount < Ltable (0.119 <0.157) and the control class with Lcount <Ltable (0.088 <0.157). Thus, it can be concluded that the pretest and posttest data in the experimental and control classes were normally distributed at the significance level.

A homogeneity test was carried out to find out whether the data was homogeneous or not. To carry out the homogeneity test, Fisher's test is used, The sample has a homogeneous variance if Fcount <Ftable at a significant level α = 0.05. The summary of the results of the data homogeneity test in the experimental class and control class can be seen in Table 11.

Table 11. Summary of Data Homogeneity Test with Fisher's Test

No.	Data	Class	F count	F table	Conclusion
1	Pretest	Experiment	0,52	1,83	Homogeneous
2	Pretest	Control			
3	Posttest	Experiment	1,11	1,83	Homogeneous
4	Posttest	Control			

Based on table 11, it can be seen that the results of the calculation of the pretest data homogeneity test in the experimental class and control class at a significant level α = 0.05 obtained Fcount <Ftable (0.52 < 1.83), and it can be concluded that the pretest data in the two classes have the same or homogeneous variance. Then, in the posttest data homogeneity test in the experimental class and control class at a significant level α = 0.05 obtained Fcount <Ftable (1.11 <1.83), it can be concluded that the posttest data in the two classes have the same or homogeneous variance.

Hypothesis testing in this study was carried out using the t test formula. The t-test was conducted to find out whether there were significant differences between learning outcomes in classes taught using interactive multimedia-based learning media (the experimental class) and learning outcomes taught using printed books (the control class). The calculation results obtained tcount = 1.89 and ttable = 1.66, so that tcount > ttable at a significant level α = 0.05. Based on these results, H0 is rejected and Ha is accepted, or, in other words, there is a significant difference between student learning outcomes in the experimental and control classes at a significance level of 5%. Thus, the learning outcomes of students who are taught using interactive multimedia-based learning media differ from those of students who are taught with printed books.

To test the effectiveness of the developed interactive multimedia-based learning media, the following calculations are carried out:

$$X = \frac{number\ of\ students\ who\ complete}{total\ number\ of\ students} \times 100\%$$
$$= \frac{28}{32} \times 100\%$$
$$= 87,50\%$$

The value of the effectiveness of printed books can be seen as follows:

$$X = \frac{number\ of\ students\ who\ complete}{total\ number\ of\ students} \times 100\%$$
$$= \frac{23}{32} \times 100\%$$
$$= 71,87\%$$

Based on the calculation of the effectiveness test on both, the result is that the learning outcomes of students who are taught with interactive multimedia-based learning media are higher than the learning outcomes of students with printed books (87.50% > 71.87%). Thus, it can be concluded that interactive multimedia-based learning media are more effective in learning Mandarin than printed books.

3.2 DISCUSSION

Based on the results of the validation that has been carried out, interactive multimedia-based learning media products are declared feasible to continue in field trials. The developed interactive multimedia-based learning media has met the standards based on the design of the development of learning materials and learning media. For the assessment of learning material experts, a score of 88.23% was obtained, which was categorized as very feasible; for the assessment of learning media experts, a score of 89.41% was obtained, which was categorized as very feasible; and for the assessment of learning design experts, a score of 90% was obtained, which was categorized as very feasible.

After the experts stated that this interactive multimedia-based learning media product was very feasible to be tested in the field, field trials were carried out according to the procedure, namely individual trials, small group trials, and field trials. The score of student responses in individual trials was 90% (Very Eligible), small group trials were 93.80% (Very Eligible), and field trials were 94.31% (Very Eligible). Based on the results of the questionnaire, which were validated by material and media experts and then continued with product trials, it can be concluded that interactive multimedia-based learning media in Mandarin are declared very suitable for use as learning media.

Testing the effectiveness of the product on the developed interactive multimedia-based learning media has been carried out by comparing the average value of student learning outcomes taught using interactive multimedia-based learning media with those using printed books. From the results of research data processing, there were differences in learning outcomes between students who were taught using interactive multimedia-based learning media and those who used printed books (87.50% > 71.87%).

This is in line with Munir [37]. Interactive multimedia is multimedia that is made with a display that fulfills the function of conveying information or messages and has interactivity for its users. While learning multimedia is the application of multimedia use in the learning process, it can be said that in the process of communication or channeling messages, the use of various media is used to stimulate students to pay attention and have the will so that the learning process can occur. According to Sanaky [38], multimedia in the learning process is the use of various types of media together, such as text, video, images, and others, with all media uniting to achieve the learning objectives that have been formulated.

Furthermore, according to Daryanto [39], interactive multimedia is multimedia that is equipped with a controller for user use, so it is up to the user to decide or choose the process of running the multimedia. While learning is defined as a process of creating an environment in which the learning process occurs, According to Surjono [40], interactive learning multimedia is a learning program that combines text, images, videos, animations, etc. with the help of a computer to achieve learning objectives, and users can actively interact with the program.

Interactive multimedia-based learning media can help students learn Mandarin [41]. The effectiveness of using interactive multimedia learning media shows higher student learning outcomes when using interactive multimedia learning media compared to conventional media such as books [42]. According to Putri [43], interactive multimedia-based learning media can be called a good learning media if the learning media can improve student learning outcomes. The use of interactive multimedia-based learning media allows students to more easily understand and master learning material.

This is also in accordance with the results of the development of interactive multimedia-based learning media, which obtain feasible results in terms of product development and are effective in improving student learning outcomes in Mandarin subjects. In addition to the use of this medium, the ability of the teacher also plays an important role as a motivator, which greatly influences student learning outcomes.

4. CONCLUSION

Based on the formulation of the problem, objectives, results and discussion of research on the development of interactive multimedia-based learning media that have been described previously, the following conclusions can be drawn:

1. Learning media products based on interactive multimedia developed for SMA Santo Thomas 1 Medan students have met the requirements and are suitable for use as learning media.

2. The effectiveness of the developed interactive multimedia-based learning media is considered more effective than printed books. The results of testing the hypothesis prove that there is a significant difference between the learning outcomes of students who are taught using interactive multimedia-based learning media and the learning outcomes of students who are taught using printed books.

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Project-Based Learning Interactive Media: Improving Learning Outcomes Special Makeup in Skin and Hair Beauty

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Abstract: Technological advances and developments have affected the world of education; it is necessary to develop learning media to meet the needs of students. The learning media developed are interactive media based on project-based learning. This study aims to develop interactive media and determine the feasibility and effectiveness of interactive media products based on project-based learning in special makeup subjects in skin and hair beauty at SMK Negeri 1 Takengon. The research method is Research and Development (R&D) which was developed using the Borg and Gall model with 10 steps, namely Conducting Preliminary Research and Information Gathering, Planning, Developing Initial Products, Conducting Initial Field Tests, Revision of Main Products, Conducting Field Tests, Conducting Revisions to Operational Products, Conducting Field Trials, and Revisions to the Final Product. The results of development research obtained interactive media based on project-based learning that were very feasible by media experts (4.25), material experts (4.28), and design experts (4.61), as well as field trials on students with an average (4.13), which was relatively high. In measuring the level of effectiveness using the N-gain score, namely 0.63 in the medium category, Based on the results of the data analysis, this learning medium can be used for the learning process.

Keywords: interactive media; project-based learning; special make-up; skin and hair beauty

1. INTRODUCTION

Vocational High School is a secondary educational institution with the specific purpose of preparing its graduates to be ready for work. Vocational education has various meanings, but one can see a common thread. According to Evans in Aini [1], "Vocational education is part of the education system that prepares a person to be more capable of working in a group of jobs or one field of work than in other fields of work," with the understanding that every field of study is vocational education as long as the field of study is studied more deeply and this depth is intended as a provision to enter the world of work.

The Department of Makeup at SMK Negeri 1 Takengon is one of the majors in the tourism department at SMK Negeri 1 Takengon. The department has subjects that play a role in developing knowledge and skills in the field of beauty, such as Special makeup. Special Makeup is one of the productive subjects in the 2013 curriculum program, which has been used by SMK Negeri 1 Takengon and is studied in class XI. One of the basic competencies of Special Makeup subjects is stage makeup.

Stage makeup is facial makeup used for the occasion of staging or performances on stage, according to the purpose of the performance. This makeup consists of: Make-up for dancers' stage faces; make-up for fashion shows; theater makeup [2].

Danker [3] stated that in today's digital era, traditional teacher-centered learning media, or the Teacher-Centered Approach, are no longer suitable for use in everyday learning processes. Because in the future, the learning process will be more modern and student-centered (a student-centered Approach). Ertmer & Ottenbreit [4] further stated that the teacher only acts as a motivator and facilitates students by utilizing existing internet technology as a way to access teaching materials from anywhere, anytime, with anyone, and with anything online.

Interactive media is a media system that processes the delivery and presentation of material under computer control to users (students) who not only hear and see video and sound but also provide an active response, and that response determines the speed and sequence of presentation [5].

In addition, students can also study independently with interactive learning media so that they will more quickly understand the subject matter. Learning media functions to convey messages (knowledge, skills, and attitudes) and can stimulate students' choices, feelings, attention, and progress so that the learning process occurs, is purposeful, and is controlled. Interactive media is media that is equipped with a controller that can be operated by the user so that the user can choose what he wants for the next process [6].

1.1 The Nature of Learning and Learning Outcomes of Special Makeup on Stage Makeup

According to Slameto [7], learning is a process of effort by a person to obtain a new change in behavior as a whole as a result of his own experience in interaction with his environment. According to Skinner, as quoted by Sagala [8], learning is a process of adaptation or adjustment of behavior that takes place progressively, while the notion of learning according to Gagne, as quoted by Sagala [8], is a process in which an organism changes its behavior as a result of experience. Meanwhile, the opinion put forward by Vygostky, as quoted by Slavin [9], states that learning is the social interaction of students with the

surrounding environment, including the environment internally and externally.

Learning outcomes are the most important part of learning. According to Sudjana [10], defining student learning outcomes is essentially a change in behavior as a result of learning in a broader sense, covering the cognitive, affective, and psychomotor fields. Dimyati and Mudjono [11] also stated that learning outcomes are the result of an interaction of acts of learning and acts of teaching; from the teacher's point of view, the teaching act ends with the process of evaluating learning outcomes, while from the students' side, the learning outcomes are the end of teaching from the top of the learning process.

Special facial makeup is used to highlight the beautiful parts of the face and cover the imperfect parts of the face. The development of cosmetology goes so fast. This is based on the importance of cosmetology itself [12]. Make-up is to beautify oneself so as to inspire self-confidence; the art of make-up is a combination of two elements. First, to beautify the face by highlighting parts of an already beautiful face. And the second is to disguise or cover up the flaws found on the face [13].

The purpose of doing makeup is to further beautify one's face because there is no certain pattern that can be used to apply makeup, so the main action is to highlight the good parts of the face and hide the less beautiful parts with cosmetic applying skills. As written by Anita [14], Corrective make-up aims to beautify the face and improve and perfect the shape of the face by displaying the beautiful parts and disguising the less beautiful parts with the help of tools, cosmetics, and make-up. This subject is taught at SMK Cosmetology as a productive subject; the material taught includes special makeup, stage makeup, TV makeup, character makeup, fantasy makeup, and photo makeup, but in this study the researchers focused on developing media only on stage makeup material.

Stage make-up is facial make-up that is used for the occasion of staging or performances on stage, according to the purpose of the show. Stage makeup is facial makeup with an emphasis on certain effects, such as the eyes, nose, lips, and eyebrows, so that special attention is paid to the face. This makeup is to be seen from a distance under bright lights (spot light), so the special makeup that is applied is quite thick and shiny, with clear facial lines, and creates an eye-catching contrast. Stage make-up, including evening make-up, developed from the make-up worn by performers at opera performances or other performances since the golden age of Rome. The rapid development of technology, especially in the use of lamps with very strong light effects for stage lighting, demands more extreme make-up. Stage make-up is applied to appearances on stage, for example, for models at fashion shows, singers at musical shows, theater performers, and dancers [15].

The purpose of stage make-up is to meet the needs and requirements of certain characters, roles, and themes based on the concept of staging goals. The purpose of this is as make-up or corrective make-up, which is to cover deficiencies in a person's face and highlight parts of the face that are already beautiful, especially for an artist, actor, model, dancer, and so on [16].

1.2 The Nature of Interactive Media
According to the Educational Communication Technology Association in Rahardi [17], learning media is everything that people use to convey messages. According to Miarso et al. [18], learning media is anything that can stimulate the teaching and learning process. Based on some of these descriptions, it can be concluded that learning media is a tool used to channel messages or information (learning material) as well as to stimulate students in the teaching and learning process to achieve the learning objectives that have been formulated.

Learning media comes from two words, namely media and learning According to Arsyad [19], the word media comes from the Latin medium, which literally means 'middle', 'intermediary', or 'introduction'. In Arabic, the media is an intermediary, or the delivery of messages from the sender to the recipient of the message. In this sense, teachers, textbooks, and the school environment are media. More specifically, the notion of media in the teaching and learning process tends to be interpreted as graphic, photographic, or electronic tools to capture, process, and reconstruct visual or verbal information.

Indriana [20] states that the function of the media is to direct students to gain various learning experiences. According to Arsyad [21], One of the main functions of learning media is as a teaching aid, which also influences the climate, conditions, and learning environment that are laid out and created by the teacher. Another opinion, according to Miftah [22], The role of the media in learning activities is one that greatly determines the effectiveness and efficiency of achieving learning objectives. Learning media is a tool used with the aim of channeling the sender's message to the recipient so that it can stimulate the interests, thoughts, feelings, and attention of students or encourage them to study harder.

Levied and Lentz [23] argue that learning media, especially visual media, have four functions, namely attentional functions, affective functions, cognitive functions, and compensatory functions. The function of attention is that visual media can attract or direct students' attention so they can concentrate on the learning content contained in the media. The affective function, namely visual media, can be used to create a sense of pleasure or student interest in learning content. Cognitive function means that visual media can make it easier for students to understand messages or information conveyed in learning. Meanwhile, in the compensatory function, visual media can accommodate weak students in accepting learning content.

1.3 Nature of Adobe Animate CC
According to Saputro [24], Adobe Animate CC is software used to create animations, animated videos, learning media, games, Android applications, websites, and so on. Adobe Animate CC is software that can work like its predecessor, Adobe Flash Professional. Adobe Animate CC is the latest version of Adobe Flash CS6, which was developed by Adobe. Adobe Animate CC is a replacement software that complements the existing deficiencies in Adobe Flash by adding its newest features, such as the use of HTML5 Canvas and WebGL. Adobe continued to develop Flash until it changed its name to Adobe Animate CC and supports web developers to design HTML5 animations, animated advertising media, animated videos, learning media, web versions of games, and many more.

Learning media contain simple animations that can be used as a stimulus for students to achieve learning goals. According to Wibawanto [25] Adobe animate cc there are facilities for making animation with several methods, namely: (1) Frame by frame animation, namely animation using several sequential images, for example animated characters making gestures, animated effects of water movement, animated effects of fire

movement, etc.; (2) Motion guide animation, namely animation that uses two keyframes by moving one object from one point to another, without changing its shape; (3) Motion guide animation, namely motion tween animation that uses trajectories so that changes in motion can be adjusted according to the desired trajectory; (4) Masking animation, namely animation that displays an area and hides another area by covering it with an object on it; and (5) Shape tween animation, namely animation based on changes in object shape, for example animation from a circle shape to a star shape, so the shape tween technique can be used.

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1.4 The nature of the Project-Based Learning Model

Project-based learning focuses on active learning where students explore authentic questions or assignments, develop plans, reflect on evaluating solutions, and produce multiple representations of ideas. Blumenfed views project-based learning as a comprehensive instructional approach that can motivate children to think about what they are doing, not just focus on getting it. Project-based learning is a learning method based on project-based learning, which involves students working in groups to compile an experimental report or other project-based learning [26].

Komalasari [27] confirms that project-based learning and structured tasks Project Based Learning is a learning approach that requires comprehensive learning where the student or class learning environment is designed so that students can carry out

investigations of authentic problems, including deepening the material of a subject matter and carrying out other meaningful assignments.

Project-based learning is an innovative learning model or approach that emphasizes contextual learning through complex activities. Project-based learning involves the use of projects as a learning model. Project-Based Learning places students in an active role, namely as problem solvers, decision makers, researchers, and document makers. Project-Based Learning: Students plan and carry out investigations of several topics or themes that use cross-subjects or cross-materials in learning.

According to Stripling and Sani [28], the characteristics of effective project-based learning are: (1) Directing students to investigate important ideas and questions; (2) being a process of inquiry; (3) being related to the needs and interests of students; (4) being centered on students by making products and making presentations independently; (5) Using creative, critical, and information-seeking skills to conduct investigations, draw conclusions, and produce products; and (6) being related to authentic real-world problems and issues.

Based on the results of a review of project-based learning, several important characteristics of project-based learning were put forward, namely as follows: (1) Focus on problems for the assignment of important concepts in lessons; (2) Making project-based learning involves students in conducting constructive investigations; (3) Project-based learning must be realistic; and (4) Project-based learning must be planned by students.

Figure 1. Display of interactive media based on project-based learning on makeup subjects specifically majoring in skin and hair beauty with Adobe Animate CC

The research problem is formulated as follows: (1) How to develop interactive media based on project-based learning on make-up subjects specifically majoring in skin and hairstyling? (2) Is interactive media based on project-based learning on special makeup subjects appropriate for use in skin and hair beauty majors? (3) Is interactive media based on project-based learning on special makeup subjects effectively used in beauty majors? skin and hair?

2. METHOD

This type of research is called research and Development (R&D) research. Sukmadinata [29] Research and Development (R&D) is a process or set of steps to develop a new product or improve existing products that can be accounted for. Richey and Klein [30] stated that R&D research is a systematic study related to design, development, and evaluation that aims to

develop products that are either educational or not related to the latest findings in products and devices.

This research will be conducted at Vocational High School (SMK) Negeri 1 Takengon, Jln. Lebe Kader Lr. Sejahtera, No. 13, Blang Kolak I, Central Aceh District, Aceh Province, in the Department of Beauty, Class XI KcI and Class XI Kc2 Academic Year 2022/2023.
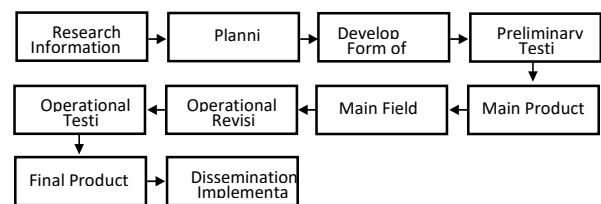
Figure 2. Borg & Gall Development Model (Source: Borg & Gall [31])

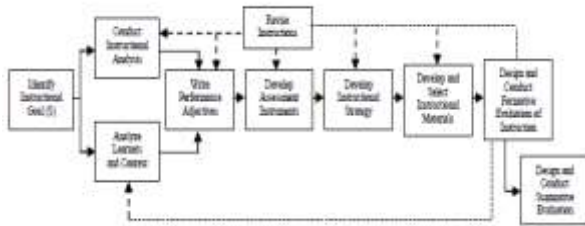The 10 steps for the Dick & Carey learning design model are as shown in Figure 2 below

Figure 3. Dick & Carey Learning Design Model

Applying the study of the percentage table that presents the feasibility aspect, Arikunto [32] makes the percentage scale table as follows:

Table 1. Percentage Scale

Achievement Percentage	Value Scale	Interpretation
76% ≤ skor ≤ 100%	4	Very Eligible
51% ≤ skor ≤ 75%	3	Decent
26% ≤ skor ≤ 50%	2	Fairly Decent
0% ≤ skor ≤ 25%	1	Inadequate

Questionnaire data analysis was carried out in the following steps: (1) Examination of the expert validation questionnaire that had been filled out by the validator; (2) Questionnaire answers for each statement are given a score that corresponds to a predetermined weight; (3) Make data tabulations; (4) Calculating the percentage of existing sub-variables with the formula for calculating the percentage of scores; and (5) The percentage is converted into a table.

The effectiveness of project-based learning-based interactive media is measured by measuring the increase in the extent to which targets are achieved from the start before treatment (initial ability test or pretest) to the target learning outcomes after being given treatment (posttest).

Testing the effectiveness of Scandura structure-based e-learning tools uses manual calculations, namely the N-Gain effectiveness formula. The Normalized Gain Test (N-Gain) was carried out to find out how much effect the Scandura structure-based e-learning tool received after being given learning on it. Archambault [33] describes the calculation of the normalized Gain score by the formula:

$$\text{N-Gain Score} = \frac{Skor\ Posttest - Skor\ Pretest}{Skor\ Maksimal - Skor\ Pretest}\ x\ 100\%$$

Hake [34] explained that the results of the Normalized Gain calculations were then interpreted based on the N-Gain interpretation table.

Table. 2. Criteria for N-Gain Score

N-Gain Presentation	Criteria
71 – 100%	High
31 – 70%	Moderate
1 – 30%	Low

3. RESULTS AND DISCUSSION
3.1 RESULTS

The results of the assessment by media experts, material experts, individual trials, small group trials, and limited field trials for all aspects of the assessment are determined by the average score. The results of the assessment are then analyzed and determined to determine whether or not it is appropriate to develop project-based learning-based interactive media. The average percentage of the results of the assessment of media experts, material experts, individual trials, small group trials, and field trials is shown in Table 3 below:

Table 3. Feasibility of Project-Based Learning Interactive Media

No	Categorization	Percentage of average score%	Criteria
1.	Material Expert Validation	4,28	Is very feasible
2.	Media Expert Validation	4,25	Is very feasible
3.	Learning Design Validation	4,61	Is very feasible
4.	Preliminary Field Test	4,24	Is very feasible
5.	Main Trial	4,16	Is very feasible
6.	Operational Trial	4,13	Is very feasible
Rata-rata		4,28	Is very feasible

Based on Table 6, it can be concluded that the scoring intervals for material expert validation, media expert validation, learning design validation, initial field trials, main trials, and operational trials show an average of 4.56 with very feasible criteria. So the application of project-based learning-based interactive media is very feasible and appropriate to be taught to class XI Beauty Counseling students at SMK Negeri 1 Takengon.

Measuring effectiveness is done by doing a pretest and a posttest. During the pretest, students are given interactive learning media based on project-based learning, while in the posttest phase, it is carried out after students have experienced the teaching and learning process using interactive learning media based on project-based learning.

From the data calculated using SPSS 16.0 for Windows, there are differences in the mean results in the pre-test and post-test. The scores of the pre-test and post-test results can be seen in Table 4 below:

Table 4. Table of Pre-test and Post-test Scores

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Sebelum diberi media	49.9000	30	15.55103	2.83922
	Sesudah diberi media	79.1833	30	8.04029	1.46795

As seen in Table 4.8, it produces a score of 49.90 in the pre-test score and a score of 79.18 in the post-test score. These data can be interpreted to mean that Ho in this research hypothesis is rejected and Ha in this research hypothesis can be accepted because the mean pre and post values change to become higher.

The paired sample T-test is also known as the mean difference test of two paired samples. The Paired Sample T-Test test is used to test whether there is a difference in the mean. The results can be seen in Table 5 below:

Table 5. Paired sample T-test

From the data in Table 5, it is produced that the value of Sig. (2-tailed) is $0.000 < 0.05$, so it can be concluded that there is a significant difference between the results of learning makeup on the pre-test and post-test data.

Data processing was carried out on the measurement results of 30 students obtained from the results of the pretest and posttest on paper. The questions were given before and after the students received instruction about makeup. Furthermore, the results of the pretest and posttest are assessed by interpretation based on the N-Gain Score criteria table, as shown in Table 6 below:

Table 6. Criteria for N-Gain Score

Criteria	Limitation
High	N-Gain score ≥ 0.7
Moderate	$0.3 \leq$ N-Gain score ≤ 0.7
Low	N-Gain score ≤ 0.3

The N-Gain Score is used to see a comparison between the gain or achievement scores obtained by students and the highest acquisition or achievement scores that students might get. The scores obtained after the pretest and posttest were carried out can be seen in Table 7 as follows:

Table 7. Pretest and Posttest Test Results

No	Value		N-Gain Score	Criteria
	Pretest	Posttest		
1	40	80	0.67	Moderate
2	50	85	0.7	High
3	70	90	0.67	Moderate
4	70	85	0.5	Moderate
5	40	70	0.5	Moderate
6	67.5	87.5	0.62	Moderate
7	72.5	90	0.64	Moderate
8	45	85	0.73	High
9	35	65	0.46	Moderate
10	30	77.5	0.68	Moderate
11	25	60	0.47	Moderate
12	35	72.5	0.58	Moderate
13	55	72.5	0.39	Moderate
14	35	82.5	0.73	High
15	70	80	0.33	Moderate
16	45	80	0.64	Moderate
17	25	60	0.47	Moderate
18	30	80	0.71	High
19	30	72.5	0.61	Moderate
20	40	75	0.58	Moderate
21	72	90	0.64	Moderate
22	70	87.5	0.58	Moderate
23	65	85	0.57	Moderate
24	51	80	0.59	Moderate
25	45	79	0.62	Moderate
26	50	83	0.66	Moderate
27	60	80	0.5	Moderate
28	55	76	0.47	Moderate
29	54	80	0.57	Moderate
30	65	85	0.57	Moderate
Total	1497	2375.5	0.63	Moderate
Mean	49.90	79.18	0.63	
Hasil Penilaian	Keefektivan Kategori "Sedang"			

From Table 7 above, it shows that each student gets varied results. Overall, it was found that the use of interactive learning media based on project-based learning provided a significant increase in learning outcomes for students in class XI at SMK Negeri 1 Takengon.

3.2 DISCUSSION

Data obtained from the validator and productive subject teacher, TKKR (Skin and Hair Cosmetology), SMK Negeri 1 Takengon, in the form of qualitative data were converted into quantitative data scores. The scoring rules are adjusted to the assessment using a Likert scale. The score is converted into a product feasibility level with reference to the ideal assessment criteria. To find out the feasibility of the project-based learning-based interactive media that was developed, validation was carried out by material experts, media experts, learning design experts, and productive teachers. Where the validator and the teacher give an assessment of each indicator contained in the learning media validation sheet in the form of an assessment questionnaire, which is expressed in the distribution of scores and categories of rating scales.

Material expert validation, it is known that the assessment is based on material coverage, material accuracy, sophistication, developing contextual insights, quality of learning strategies, quality of learning materials, and quality of learning media. At the Material Expert Validation stage, I achieve an average score of 4.37 "Decent" criteria, and improvements are made based on suggestions and input from material experts. The validity of the first material suggests that operational words in the media must be emphasized or sharpened and states that this medium is suitable for use with a little revision. In the material expert validation stage II, it achieved an average score of 4.20 with the criteria of "Decent". In addition, the validator suggests using simpler and clearer sentences so that students can understand them more easily.

Media expert validation is known based on layout design/layout, text/typography, image, animation, audio, video, packaging, use, navigation, and interactive links. Stage I of media expert validation obtained an average of 3.72 with the criteria of "Not Eligible" . In addition, the validator stated that the media design was good, the menu display was also in accordance with the level of students who used it, but the animation was less attractive, the choice of colors and the shape of the learning media layout were interesting, and the media

used more animation than pictures because the strength of the media was in visualization and animation. In the second stage of the media expert validation, an average score of 4.78 was obtained with the "Decent" criteria. And on average, validation stages I and II get an average score of 4.25 with the "Decent" criteria. The validator also suggested that learning media should be revised to use as little writing as possible, more illustrations with more diverse images, and appropriate backsounds.

Validation of learning design experts in the validation of stage I design experts based on learning approaches, concept truth, concept depth, concept suitability, learning activities, experimental activities, implementation, assessment, content, visualization, and sentence clarity received an average rating of 4.46 with the criterion "worthy.". In addition, the validator stated that the layout design of the learning media was not attractive, the concept map design was not attractive, and the contents and guidelines for using instructional media were not clear, using original pictures instead of cartoons. In the second phase of the design expert validation, an average rating of 4.75 was obtained with the "Decent" criteria. The validator also suggested that learning media should be revised to use more diverse colors and not be too colorful.

Based on the validator's assessment of the interactive media based on project-based learning that was developed as well as the suggestions and input provided by material experts, learning design experts, media experts, and class teachers, the interactive media based on project-based learning that was developed is said to be valid and feasible to be used in learning.

The effectiveness of interactive media based on project-based learning in learning can be seen through the completeness of student learning and the increase in N gain scores obtained from learning outcomes tests in the form of pretests and posttests, which are given at the beginning of learning and at the end of learning activities that have been carried out. Data from the learning outcomes test given to students before using interactive media based on project-based learning is in the form of a pretest, which totals 40 multiple choice questions consisting of five choices, namely a, b, c, d, and e.Student pretest data, as shown in Table 4.9, shows that student learning outcomes are still low, with an average of 49.9. This is seen based on the minimum completeness criteria based on reference to the school's minimum completeness criteria for Productive subjects, namely 75.

After learning activities using interactive media based on project-based learning are completed, a posttest is carried out at the end of the meeting to see student learning outcomes. From the posttest carried out, it can be seen that the average student result reached 79.19. Referring to the school's minimum completeness criteria for Productive subjects, namely 75, it can be seen that there is an increase in student learning outcomes, and it can be said that student learning outcomes have reached the minimum completeness criteria (KKM).

Based on the purpose of this development research, namely "to determine the feasibility and effectiveness of interactive media based on project-based learning in special makeup subjects, majoring in skin and hair beauty at SMK Negeri 1 Takengon, this learning medium can be said to be effectively used for all students and teachers. Based on the data that can be shown, interactive media based on project-based learning in makeup subjects is effective for improving student learning outcomes.

4. CONCLUSION

1. Development of interactive media based on project-based learning in special make-up subjects majoring in skin and hair beauty at SMK Negeri 1 Takengon refers to the development model from Borg & Gall, which is simplified into five steps: (1) conducting preliminary research, (2) developing a product initial, (3) performing product validation, (4) conducting trials, and (5) making the final product.

2. Products in the form of interactive media development based on project-based learning have very feasible results to be used in the learning process in the classroom. This is supported by several validation processes involving material, media, and instructional experts, all of which are "very feasible" to use.

3. In the effectiveness test using the N-Gain Score, learning using interactive learning media based on project-based learning shows an increase in learning outcomes before and after using learning media that was developed with a value of 0.63, or getting into the "moderate" category. Thus, it can be said that interactive learning media based on project-based learning are effective for improving makeup learning for students.

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Interactive Media Based on Contextual Teaching and Learning: Improving the Learning Outcomes of Computer Systems

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Abstract: This research is motivated by the low student learning outcomes and the need to develop learning media for computer system learning. The purpose of this study was to produce appropriate and effective interactive media based on contextual teaching and learning models to improve student learning outcomes at SMK Muhammadiyah 11 Sibuluan. The type of research used is the ADDIE development model (analysis, Design, Development, implementation, and Evaluation). The research instruments used were teacher and student observation sheets, material expert validation questionnaires, media experts, design experts, and student response questionnaires. This study also uses quantitative data analysis techniques (data on the feasibility and effectiveness questionnaire assessment) and qualitative data (observation data and documentation). Product validation results show a score percentage of 85.88% for material expert validation, 89.41% for media expert validation, 86.25% for design expert validation, and 96.25% for student responses. The results of the normality and homogeneity tests show that the research data has been declared normal and homogeneous. The results of the hypothesis test show that the value of t count is 1.84 and the value of t table is 1.66, where t count > t table. The results of this study indicate that interactive media based on contextual teaching and learning models are effective in improving student learning outcomes at SMK Muhammadiyah 11 Sibuluan.

Keywords: interactive media; contextual teaching and learning; computer system

1. INTRODUCTION

The computer system is the set of elements related to carrying out an activity using a computer. The elements of a computer system consist of humans (brainware), software (software), and hardware (hardware). Thus, these components are elements involved in a computer system; of course, hardware means nothing if there is not one of the two (software or brainware). A simple example is who will turn on the computer if there is no human, or what commands the computer will execute if there is no software. The Von Neuman architecture describes a computer with four main parts: the arithmetic and logical unit (ALU), control unit, memory, and input and output devices (collectively called I/O). These parts are connected by a computer system bus to allow all components to carry out their duties.

One model that teachers can use to make computer learning more interesting is the Contextual Teaching and Learning (CTL) approach. This approach is a learning concept that helps teachers relate the material taught to students' real-world situations and encourages students to make connections between the knowledge they have and its application in their lives as members of their families and communities. With this concept, learning outcomes are expected to be more meaningful for students. The learning process takes place naturally in the form of student work and experience activities, not by transferring knowledge from teacher to student. Learning strategies are more important than results.

In this context, students need to understand the meaning of learning, what the benefits are, what status they have, and how to achieve them. They realize that what they learn is useful for

their lives later. That way, they position themselves as those who need provision for their lives later. They learn what is beneficial to them and try to achieve it. In that effort, they need teachers as directors and mentors. In classes where the teacher uses a contextual approach, the teacher's job is to help students achieve their goals in the form of basic competencies. That is, the teacher deals more with strategy than giving information. The teacher's task is to manage the class as a team that works together to discover something new for class members (students). Something new that comes from "finding yourself and not from "what the teacher said". Such is the role of the teacher in the classroom, which is managed with a contextual approach.

The application of activities to construct or build their own knowledge on students, makes students trained to reason and think critically through inquiry activities or finding problems on their own, freedom to ask (questioning), and application of learning communities (learning communities), namely training students to work together, sharing ideas, sharing experiences, sharing knowledge, and communicating with each other so that there is positive interaction between students and in the end students are actively involved in learning together.

CTL was developed with the aim of making learning more productive and meaningful. The CTL model can be implemented without having to change the existing curriculum and arrangements. Computer learning always changes from time to time. Whatever learning model is used, computer learning consists of the same components, namely, teachers, materials, methods, and media, students, and the environment. These components interact in the process of learning computer

systems to achieve learning objectives or basic competencies that have been set.

1.1 The Nature of Learning and Learning Outcomes of Computer Systems

Learning outcomes are the abilities possessed by a student after the student receives treatment from the teacher as an educator [1]. The above understanding provides an understanding that when individuals carry out learning activities, there will be changes that occur, including changes in knowledge and behavior, which are shown through test scores.

According to Suprijono in Abdulloh [2], learning outcomes are patterns of behavior, values, understanding, attitudes, appreciation, and skills. Hamalik in Hariyanto [3] reveals that learning outcomes are the occurrence of a change in behavior or character in a person that can be observed and also measured in the form of knowledge, attitudes, and skills. We can interpret this change as an improvement and also a better development, where previously those who did not know will become aware.

Bloom mentions (in Rusman [4]) that the changes that occur in learning are learning outcomes, which include changes in the cognitive, affective, and psychomotor domains. The cognitive domain is knowledge, understanding, application, analysis, and evaluation. The affective domain is the attitude toward receiving, responding, assessing, managing, and living. The psychomotor domain includes movement and acting skills, as well as verbal and non-verbal expression skills.

Based on some of the opinions of the experts above, the authors can conclude that learning outcomes are a change achieved by students, including aspects of knowledge, attitudes, and skills, through a process that is carried out repeatedly and is permanent. The indicator of achievement of learning outcomes in this study is a change in ability in the cognitive domain. Learning outcomes in the cognitive domain are measured using written test instruments in the form of multiple choices consisting of a pretest and a posttest.

The computer system is the set of elements related to carrying out an activity using a computer. Elements of a computer system consist of humans (brainware), software (software), a set of instructions (instructions), and hardware (hardware). Computer systems subjects are productive subjects given at Vocational High Schools (SMK) computer network engineering expertise programs. In computer systems subjects, there are several basic competencies: understanding the number system, applying logic relations and logic gates, understanding arithmetic operations, and understanding computer organization and architecture.

To obtain evidentiary data that explains the level of students' ability to succeed in achieving instructional goals in computer systems subjects. For research on operating computer systems on cognitive aspects or learning outcomes that emphasize more on knowledge of understanding computer organization and architecture.

1.2 The Nature of Learning and Learning Development

Learning is not only paying attention to what students learn but also how to teach students to pay attention to what will be learned. A curriculum study that places more emphasis on descriptions of what goals to achieve and what learning content students should learn Meanwhile, how to teach students places more emphasis on ways to achieve goals, which is related to how to organize learning content and manage learning [5].

The learning process occurs because of the interaction between students and their environment. Therefore, the environment needs to be arranged in such a way that student reactions arise towards the desired behavior change. The environmental settings include analyzing student needs and characteristics, formulating goals, and determining what is needed [6].

Development is a type of research that we are more familiar with under the term research and development (R&D). Development research is research that aims to use research to produce certain products and test the effectiveness of relatively new types of research.

The definition of development research according to Borg & Gall is "a process used to develop and validate educational products". Meanwhile, according to Seels & Richey, "development research is a systematic study to design, develop, and evaluate programs, processes, and learning outcomes that must meet internal consistency and effectiveness criteria.

This development research follows the steps in a cycle. The steps of this research or development process consist of a study of the research findings for the product to be developed. Developing products based on these findings, conducting field trials according to the setting where the product will be used, and revising the results of field trials The research procedure (ADDIE) that has been implemented is described by identifying systematic stages in developing computer system learning.

1.3 Learning Model Contextual Teaching and Learning

Contextual Teaching and learning, commonly called contextual learning, is a holistic learning concept in which learning material is associated with the surrounding environment or the context of daily life, both social, cultural, and personal, so that it will produce meaningful learning and students can have knowledge and skills that can be applied to various problems [7].

Agreeing with Soimin's statement, Elaini B. Johnson in Rusman [8] says, "Contextual learning is a learning system that fits the brain that generates meaning by connecting academic content with context in students' daily lives". Concluded that the essence of contextual learning is the linkage between learning material and the experience or environment around students, so that students will play an active role in connecting their abilities because they try to learn subject matter and also associate it with the surrounding environment and are able to apply it,

Contextual learning is an alternative learning model that can help teachers create a pleasant learning climate and make learning more meaningful because learning is not only an understanding of abstract knowledge; students are also faced with clear learning activities because they are concrete, that is, they are related to the surrounding environment. As Nurdyansyah et al. [9] argue, the CTL approach is "Learning that allows students to apply and experience what is being taught by referring to real world problems, so that learning will become more meaningful and enjoyable".

The teacher, as a measure of the success of learning, must be able to create learning scenarios so that the learning carried out will run smoothly. Likewise, the application of contextual learning can be successful. The steps in developing CTL according to Rusman [10] are: (1) Developing students' thinking to carry out more meaningful learning activities, whether by working alone, finding themselves and constructing new knowledge and skills of students; (2) Carry out inquiry activities on all topics taught; (3) Developing the curiosity of students through the questions asked; (4) Creating learning communities, such as through group discussion activities, question and answer, and so on; (5) Presenting models through learning examples through illustrations, models, even actual media; (6) Familiarize children to reflect on every learning activity that has been carried out; and (7) Conduct an objective assessment, namely assessing the actual ability of each student.

1.4 The Nature of Computer System Interactive Learning Media

Teaching and learning activities carried out both in schools and tertiary institutions, in addition to requiring accuracy in choosing strategies, models, and learning methods, also require a medium that is used to convey learning material. The word media comes from the Latin word medium," which means intermediary or introduction. Media is a tool for channeling messages from senders and recipients so that they can stimulate the thoughts, feelings, interests, and attention of students in such a way that the learning process occurs [11].

Choosing a media for learning needs is not easy, it must consider several factors. As expressed by Dick, W., And Carey [12], three factors cause compromise in the selection of media and delivery systems: (1) the availability of existing instructional material; (2) production and implementation constraints; and (3) the amount of facilitation provided by the instructor during instruction. This means that there are three factors that are often considered in the selection of media in the learning process: (1) the availability of existing teaching materials; (2) production and implementation constraints; and (3) the facilitation provided by the teacher during the learning process. The media plays an important role as an intermediary to make it easier for teachers in the teaching and learning process to achieve several criteria related to the media that have been discussed, including reference material and considerations for teachers in choosing or creating media.

Learning media is anything that can be used to channel messages from the sender of the message to the recipient so that it can stimulate the thoughts, feelings, concerns, interests, and enthusiasm of students so that the teaching and learning process occurs. According to Gagne (in Arsyad [13]), learning media only includes tools that are physically used to convey the contents of teaching material to students, which consist of, among others: books, tape recorders, videos, films, slides, pictures, and other material objects.

The use of media for abstract learning materials can be concreted and makes an unattractive learning atmosphere interesting. Many learning media are created for independent learning at this time, but finding a choice or solution that is really good for the learning process to be effective, interesting, interactive, and fun is a problem that needs to be solved. This is needed to create human qualities that do not only depend on verbal transfer of knowledge, both of which are carried out by schools and non-formal educational institutions at this time.

Utilization of computers in learning media requires supporting applications that are in accordance with the objectives of developing learning media. One medium that is suitable for use with existing problems in the field is the Macromedia Flash application. Based on the learning conditions of computer systems that have been described, it is necessary to conduct research to increase the competence of students' computer systems, namely by developing computer system learning media with macromedia flash software, which can improve student learning outcomes and improve the quality of teaching computer systems in vocational schools.

The research problems are formulated as follows: (1) Is interactive media based on Java program models suitable for use in learning computer systems? (2) Is interactive media based on Contextual Teaching and Learning in computer system learning effectively used in improving student learning outcomes?

2. METHOD

This type of research is a type of development research, commonly called development (Research and Development). Development research is research that aims to produce a product through the development process [14]. According to Sugiyono [15], research and development are both research that produces products and other activities, namely testing the effectiveness of the products to be produced. In order to be able to produce a particular product, namely research that needs analysis in nature and to test the effectiveness of the product so that it can function for a large audience, research must be carried out to test the effectiveness of the product that has been produced.

In the ADDIE model, there are several stages, namely: analysis, Design, Development, implementation, and Evaluation. The following are products with the ADDIE model:
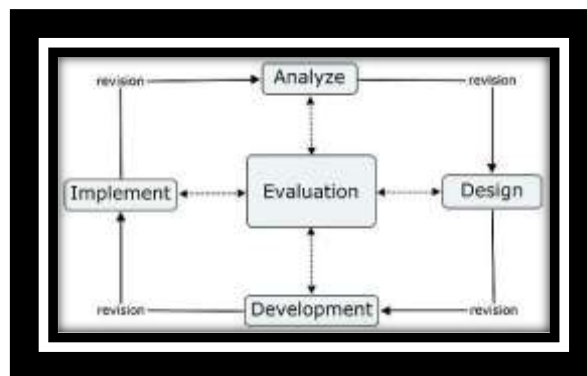

Figure 1. Stages of the ADDIE Model

In this study, models and development procedures were used with the ADDIE model as previously stated for each stage: analysis, design, development, implementation, and evaluation, based on what was stated by Branch [16], namely: Analyze, Design, Development, Implementation, and Evaluation.

This research was conducted in class X Computer and Network Engineering at SMK Muhammadiyah 11 Sibuluan Tapanuli Tengah in the even semester of the 2022/2023 academic year. Class X TKJ is the target audience for the research. The subjects of this study were students of class X at SMK Muhammadiyah 11 Sibuluan Tapanuli Tengah. As for class X TKJ 1 as the experimental class and class X TKJ 2 as the

control class, The selection of subjects in this study used a purposive sampling technique, namely the determination of the research sample based on the considerations of the researcher, who considered the desired research elements already existed in the members of the sample taken, and based on suggestions from the study teacher at the school.

Data collection techniques in this study are as follows: (1) Observation. Observations were made with the aim of observing the learning process, especially the results of students and teachers in applying the CTL approach at SMK Muhammadiyah 11 Sibuluan; (2) a questionnaireThe questionnaire contains a number of written questions that are used to obtain information from respondents. This method is used to retrieve validation data for interactive media based on the CTL learning model from a team of experts (lecturers) regarding the feasibility assessment and student response questionnaires regarding interactive media based on the CTL learning model in computer system learning; (3) Learning Outcomes Test Questions. Test questions are used to obtain data in the form of the results of students' cognitive abilities in learning computer systems. The level of difficulty of the questions used for the pretest and posttest is the same. The preparation of the test begins with the creation of a grid of multiple-choice questions.

Table 1. Feasibility Interpretation

Interval	Interpretasi	
0.00 – 2.49	Not good	Not feasible
2.50 – 3.32	Pretty good	Less Eligible
3.33 – 4.16	Good	Worthy
4.17 – 5.00	Very good	Very Worth it

(Sumber : Sriadhi [26])

This research was said to be successful if the results obtained from the questionnaire met the criteria of "Very Good" or "Very Eligible" and "Good" or "Decent" with a score interval of 3.33-5.00.

The practicality of the learning model developed in this study was measured using a questionnaire assessing the use of the learning model in the learning process. The practicality value can be calculated using the formula in Table 3 below:

Table 2. Criteria for the Practicality of the Learning Model

Score Interval	Criterion
3,5 – 4,00	Very Practical
3,00 – 3,49	Practically Without Repair
2,50 – 2,99	Practically Needs Improvement
2,00 – 2,49	Less Practical
1,00 – 1,99	Impractical

The effectiveness of CTL-based interactive media is developed by having two types of data, namely qualitative and quantitative. Qualitative data is generated from preliminary or feasibility studies, either in literature studies or field studies. Quantitative data were obtained from student learning outcomes using quasi-experiments, namely comparing pre-test and post-test scores of students using CTL-based interactive media. In this study, the data obtained were student learning outcomes from the experimental and control classes with the assessment criteria as seen in Table 3 below:

Table 3. Assessment Criteria

Value	Criteria	Percentage (%)
A	Very Good	81-100%
B	Good	61-80%
C	Enough	41-60%
D	Less Good	21-40%
E	Very Poor	0-20%

Data analysis in this study used quantitative descriptive analysis techniques, namely data from media experts, material experts, design experts, and student responses, as well as effectiveness tests. Data collection was carried out using a questionnaire by distributing questionnaires to the respondents, namely material experts, media experts, design experts, and students. The respondents gave an assessment of the quality of interactive multimedia-based learning media with the provisions of the research criteria in Table 4 as follows:

Table 4. Scoring Rules

No	Category	Score
1	Very good	5
2	Good	4
3	Pretty good	3
4	Not good	2
5	Not good	1

(Sumber: Arikunto [35])

The research results of each respondent calculated the average score obtained. The average score obtained is then converted into a qualitative value using the formula and basic guidelines to determine the level of validity as follows:

$$P = \frac{\sum x}{\sum x^1} \times 100\%$$

Information:
P = Large Percentage
$\sum x$ = Number of Validator Answer Scores
$\sum x^1$ = Total Highest Answer Score

Table 5. Product Validation Criteria

Percentage %	Validity Level	Information
80 – 100	Very valid	Not Revised
60 – 79	Valid	Not Revised
40 – 59	Invalid	Some Revisions
20 – 39	Invalid	Revision
0 - 19	Very invalid	Revision

(Sumber: Arikunto [36])

Data analysis of the effectiveness of interactive CTL media

Normality test.
To determine the average value, the formula is used, namely:

$$\bar{x} = \frac{\sum f_i \, x_i}{\sum f_i}$$

To calculate the standard deviation (s), the formula is used, namely:

$$s = \sqrt{\frac{n\sum x_i^2 - \left(\sum x_i\right)^2}{n(n-1)}}$$

By testing criteria:
If L0<L then the sample is normally distributed and if L0> L then the sample is not normally distributed

Homogeneity Test.

Examination of the variance homogeneity test aims to determine whether the sample data has a homogeneous variance or not. Test the homogeneity of variance using the F test, with the following hypotheses:

$H_0 : \sigma_1^2 = \sigma_2^2$ the two populations have the same variance.

$H_a : \sigma_1^2 \neq \sigma_2^2$ the two populations have different variances.

To test the hypothesis above, the following formula is used:

$$F_{hit} = \frac{\text{varians terbesar}}{\text{varians terkecil}}$$

Test Criteria are:

$F_{hit} < F_{tab 1/2\ \alpha(v1, v2)}$, H_0 accepted

$F_{hit} > F_{tab 1/2\ \alpha(v1, v2)}$, H_0 is rejected

Under the condition:

real level α = 0,05

$v_1 = n_1-1$ dan n_1 = size of the largest variance

$v_2 = n_2- 1$ dan n_2 = smallest variance size

Data processing shows that Fcount <Ftable, then H0 is accepted. It can be concluded that the two samples have a homogeneous variance. If data processing shows that Fcount > Ftable, then H0 is rejected and Ha is accepted, it can be concluded that the two samples do not have a homogeneous variance.

Research Hypothesis Test. Testing the hypothesis in this study was carried out using the one-party t-test formula where the statistical hypothesis being tested can be formulated as follows:

Ha: There are differences in the learning outcomes of students who study using CTL-based interactive media and students who study with printed books.

Ho: There is no difference in the learning outcomes of students who study using CTL-based interactive media with students who study with printed books.

To find out significant differences in student learning outcomes, the t test formula is as follows::

$$t = \frac{\overline{X}_1 - \overline{X}_2}{s\sqrt{\dfrac{1}{n_1} + \dfrac{1}{n_2}}}$$

Where S is the combined variance calculated by the formula:

$$S^2 = \frac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{n_1 + n_2 - 2}$$

Information:

t = calculated t value obtained

$\overline{X}_1$ = Average score of the experimental class sample

$\overline{X}_2$ = Average score of the control class sample

n_1 = the number of subjects in the experimental group

n_2 = number of control group subjects

S_1^2 = standard deviation of the experimental group

S_2^2 = standard deviation of the control group

S = combined variance

The test criteria are that Ha is accepted if tcount < ttable and Ho is rejected if tcount > ttable which is obtained from the t distribution list with dk = (n – 1) and level α = 0.05. To see the value of the effectiveness of CTL-based interactive media that is being experimented on, the effectiveness calculation formula is used as follows:

$$X = \frac{\text{number of students who completed}}{\text{total number of students}} \times 100\%$$

3. RESULTS AND DISCUSSION

3.1 RESULTS

The results of the assessment by media experts, material experts, individual trials, small group trials, and limited field trials for all aspects of the assessment are determined by the average score. The results of the assessment are then analyzed and determined to determine whether or not it is appropriate to develop interactive multimedia-based learning media. The average percentage of the results of the assessment of media experts, material experts, individual trials, small group trials, and field trials is shown in Table 6 below:

Table 6. Feasibility of CTL-based interactive media

No	Categorization	Percentage of average score%	Criteria
1.	Material Expert Validation	85,88	Is very feasible
2.	Media Expert Validation	89,41	Is very feasible
3.	Learning Design Validation	86,25	Is very feasible
4.	Preliminary Field Test	89,33	Is very feasible
5.	Main Trial	90,80	Is very feasible
6.	Operational Trial	96,25	Is very feasible
Average		89,65	Is very feasible

Based on Table 6, it can be concluded that the scoring intervals for material expert validation, media expert validation, learning design validation, individual trials, small group trials, and limited field trials show an average of 89.65% with very feasible criteria. So the application of CTL-based interactive media is very feasible and appropriate for learning.

Based on the learning outcomes of students who were taught using interactive CTL-based media at Muhammadiyah 11 Sibuluan Vocational School, the lowest score was 70 and the highest score was 98. The average score was 84,406, mode 83, median 84, and standard deviation 7.741. To see student scores, an interval class is used, namely the score between absolute frequency (the number of students who have learning achievement scores) and relative frequency (the number of percent of learning achievement scores). A complete description of learning outcomes using interactive multimedia-based learning media is shown in Table 7 as follows.

Table 7. Frequency Distribution of Experimental Class Student Learning Outcomes

Class	Interval Class	Absolute Frequency	Relative Frequency
1	70 – 74	4	12,5%
2	75 - 79	3	9,375%
3	80 - 84	9	28,125%
4	85 - 89	9	28,125%
5	90 - 94	3	9,375%
6	95 - 99	4	12,5%
Total		32	100%

Based on the learning outcomes of students who were taught using textbooks at SMK Muhammadiyah 11 Sibuluan, the lowest score was 70 and the highest score was 96. The mean score was 80,969, the mode was 70, the median was 81.5, and

the standard deviation was 7.137. A complete description of learning outcomes using printed books is shown in Table 8 below:

Table 8 Frequency Distribution of Control Class Student Learning Outcomes

Class	Interval Class	Absolute Frequency	Relative Frequency
1	70 - 74	5	15,625%
2	75 - 79	6	18,75%
3	80 - 84	11	34,375%
4	85 - 89	6	18,75%
5	90 - 94	2	6,25%
6	95 - 99	2	6,25%
Total		32	100%

The data normality test uses the Liliefors test with the null hypothesis (H0) which states that the sample comes from a normally distributed population. Acceptance and rejection (H0) are based on a comparison of the price of Lcount with the price of Ltable at a significant level α = 0.05. If Lcount < Ltable, then the data is normally distributed. A summary of the data normality test results in the experimental class and control class can be seen in Table 9 below.

Table 9. Summary of the Data Normality Test with the Liliefors Test

No.	Data	Class	L count	L table	Conclusion
1	Pretest	Experiment	0,089	0,157	Normal
2	Pretest	Control	0,070	0,157	Normal
3	Posttest	Experiment	0,115	0,157	Normal
4	Posttest	Control	0,102	0,157	Normal

Based on table 4.11, it can be seen that the results of the pretest data normality test in the experimental class obtained Lcount < Ltable (0.089 <0.157) and in the control class also obtained Lcount <Ltable (0.070 <0.157). The same thing also happened to the posttest data normality test results for the experimental class with Lcount < Ltable (0.115 <0.157) and the control class with Lcount <Ltable (0.102 <0.157). Thus, it can be concluded that the pretest and posttest data in the experimental and control classes were normally distributed at the significance level.

A homogeneity test was carried out to find out whether the data is homogeneous or not. To carry out the homogeneity test, Fisher's test is used, The sample has a homogeneous variance if Fcount <Ftable at a significant level α = 0.05. The summary of the results of the data homogeneity test in the experimental class and control class can be seen in Table 10.
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Table 10. Summary of the Data Homogeneity Test with Fisher's Test

No.	Data	Class	F count	F table	Conclusion
1	Pretest	Experiment	0,52	1,83	Homogeneous
2	Pretest	Control			
3	Posttest	Experiment	1,17	1,83	Homogeneous
4	Posttest	Control			

Based on Table 10, it can be seen that the results of the pretest data homogeneity test calculations in the experimental class and control class at a significant level α = 0.05 obtained Fcount <Ftable (0.52 <1.83), so it can be concluded that the pretest data in the two classes have the same or homogeneous variance. Then, in the posttest data homogeneity test in the experimental class and control class at a significant level α = 0.05 obtained Fcount <Ftable (1.17 <1.83), it can be concluded that the posttest data in the two classes have the same or homogeneous variance.

Hypothesis testing in this study was carried out using the t test formula. The t-test was conducted to find out whether there were significant differences between learning outcomes in classes taught using CTL-based interactive media (experimental class) and learning outcomes taught using printed books (control class). The calculation results obtained tcount = 1.84 and ttable = 1.66, so that tcount > ttable at a significant level α = 0.05. Based on these results, H0 is rejected and Ha is accepted, or, in other words, there is a significant difference between student learning outcomes in the experimental and control classes at a significance level of 5%. Thus, the learning outcomes of students who are taught using interactive CTL-based media differ from those of students who are taught with printed books.

To test the effectiveness of the developed CTL-based interactive media, the following calculations are performed:

$$X = \frac{number\ of\ students\ who\ complete}{total\ number\ of\ students)}\ x\ 100\%$$
$$= \frac{26}{32}\ x\ 100\%$$
$$= 81,25\%$$

The value of the effectiveness of printed books can be seen as follows:

$$X = \frac{number\ of\ students\ who\ complete}{total\ number\ of\ students)}\ x\ 100\%$$
$$= \frac{20}{32}\ x\ 100\%$$
$$= 65,5\%$$

Based on the calculation of the effectiveness test on both, the results showed that the learning outcomes of students who were taught with CTL-based interactive media were higher than those of students with printed books (81.25% > 62.5%). Thus, it can be concluded that CTL-based interactive media is more effectively used in learning computer systems at SMK Muhammadiyah 11 Sibuluan compared to using printed books.

3.2 DISCUSSION

Based on the results of the validation that has been carried out, CTL-based interactive media products are declared feasible to continue in field trials. The developed CTL-based interactive media meets standards based on the design of learning materials, learning media, and learning designs. For the assessment of learning material experts, a score of 85.88% was obtained, which was categorized as very feasible, for an assessment from learning media experts, a score of 89.41% was obtained, which was categorized as very feasible; and for an assessment from learning design experts, a score of 86.25% was obtained, which was categorized as very feasible.

After the experts stated that this CTL-based interactive media product was very feasible to try out in the field, field trials were carried out according to the procedure, namely individual trials, small group trials, and field trials. The score of student responses in individual trials was 89.33% (Very Eligible),

small group trials were 90.8% (Very Eligible), and field trials were 96.25% (Very Eligible). Based on the results of the questionnaire, which were validated by material experts, media experts, and design experts and then continued with product trials, it can be concluded that CTL-based interactive media in computer system learning is stated to be very suitable for use as learning media for students of SMK Muhammadiyah 11 Sibuluan.

The effectiveness test of the developed CTL-based interactive media was carried out to fulfill the procedures of the ADDIE model. The purpose of testing the effectiveness of this product is to determine whether it needs to be used continuously because it is effective or discontinued because it is not effective.

Testing the effectiveness of the product on the developed CTL-based interactive media has been carried out by comparing the average value of student learning outcomes taught using CTL-based interactive media with those using printed books. From the results of research data processing, there were differences in learning outcomes between students who were taught using CTL-based interactive media and those who used printed books (81.25% > 65.5%).

According to Soimin [17], contextual learning is a holistic learning concept, in which learning material is associated with the surrounding environment or the context of daily life, both social, cultural, and personal, of students so that it will produce meaningful learning and students can have knowledge and skills that can be applied to various problems.

This is in line with Rusman [18], Contextual learning is a learning system that matches the brain and generates meaning by connecting academic content with context in students' daily lives. According to Nurdyansyah [19], the CTL approach is learning that allows students to apply and experience what is being taught by referring to real world problems, so that learning will be more meaningful and enjoyable.

According to Bayuaji [20], CTL-based interactive media can improve learning outcomes more than conventional models or lectures. Then, according to Soleha [21], the application of the CTL model to learning media is a solution for developing learning that has a good influence on learning outcomes and is suitable for use as a learning medium in schools.

Furthermore, according to Merta [22], the CTL learning model in interactive media can be given an emphasis on the inquiry component so that it can help and facilitate students in learning. According to Zuhra [23], interactive media based on the CTL learning model shows decent and effective results in improving student learning outcomes. According to Novita [24], interactive learning media is effective in increasing the mastery of computer system concepts in terms of student learning outcomes, and it is found that the increase in student learning outcomes is between pretest and posttest scores.

This is also in accordance with the results of the development of CTL-based interactive media at SMK Muhammadiyah 11 Sibuluan. which obtains proper results in terms of product development and is effective in improving student learning outcomes in learning computer systems. In addition to the use of this media, the teacher's ability also plays an important role as a motivator that greatly influences student learning outcomes.

4. CONCLUSION

Based on the formulation of the problem, objectives, results, and discussion of research on the development of interactive media based on the CTL learning model that has been described previously, the following conclusions can be drawn:

1. CTL-based interactive media products developed for students of SMK Muhammadiyah 11 Sibuluan have met the requirements and are suitable for use as learning media. This was concluded based on the results of research from learning material experts (85.88%), media experts (89.41%), design experts (86.25%), student responses to individual trials (89.33%), small group trials (90.8%), and field trials (96.25%), which overall stated that CTL-based interactive media was in the "very good" category.

2. The effectiveness of the developed CTL-based interactive media is considered more effective than printed books. The results of testing the hypothesis prove that there is a significant difference between the learning outcomes of students who are taught using CTL-based interactive media and the learning outcomes of students who are taught using printed books. This is indicated by the results of data processing, tcount = 1.84 and ttable = 1.66, so that tcount > ttable at a significant level $\alpha = 0.05$. So the learning outcomes of students taught with CTL-based interactive media have an effectiveness of 81.25% higher than learning outcomes using printed books, with an effectiveness of 65.5%.

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UNO Card Media: Improving Learning Outcomes of Colors and Numbers Through the Role Play Learning Model for Kindergarten Students

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Abstract: The purpose of this research is to: (1) find out if the role play model via UNO cards is appropriate for use at the kindergarten level; and (2) know the effectiveness of the role play model through UNO cards. This type of research is R&D research using the ADDIE development model. The subjects of this study were material experts, learning model experts, learning design experts, and Tri Sakti Lubuk Pakam Kindergarten students, totaling 60 people. The results showed that (1) the criteria for the learning material expert test were very good (88.24%), (2) the criteria for the learning model expert test were very good (95.56%), and (3) the criteria for the learning design expert test were very good (95%). Based on the results of the learning tests, it is known that the average value of the control class is 68 and the experimental class is 85. The results of the submission of the hypothesis prove that (1) the role-play learning model through UNO cards is feasible to use. (2) There is a significant difference between the learning outcomes of students who use the role play learning model through UNO cards and the learning outcomes of students who do not use the role-play learning model through UNO cards. This is indicated by the results of data processing on the results of the posttest obtained by t_{count} = 10.69. At a significant level (α = 0.05) with dk 58, t_{table} = 1.16, so that $t_{count} > t_{table}$. The average effectiveness of learning outcomes in the use of the role play learning model through the Uno card is 73%, while the group of students who do not use the role play learning model through the UNO card is 36%. From this data, it is proven that the use of the role play learning model through UNO cards is more effective than without the model.

Keywords: uno card media; learning outcomes of colors and numbers; role play learning models; kindergarten

1. INTRODUCTION

In general, learning to count really requires more energy and thought because the material is difficult, especially during the developmental period of kindergarten children. Learning to count can be said to be a difficult lesson because there are many numbers and symbols to solve discussion questions. The purpose of learning to count in general to start counting in early childhood is to know the basics of learning to count so that, in time, the child will be better prepared to take part in learning to count at the next, more complex level.

Activities to build an understanding of numbers and numbers that are in accordance with the characteristics of students in learning require media. The medium to be discussed in this study is cards. Kindergarten children (TK) are usually quick to recognize and understand material with various symbols, colors, and pictures or videos. Mostly at the kindergarten level, there is a lack of understanding among children in writing and memorizing sequences of numbers on a scale of 1–10. The importance of this basic level will support and sustain the material in learning mathematics at the kindergarten level.

For this reason, the author created the title Developing a Role Play Learning Model Through Uno Cards at the Kindergarten Level as a start for improving counting material as well as the introduction and understanding of numbers and colors. The beginning of giving material to the kindergarten level is holding a pencil. The kindergarten teacher will teach how to write lines, which then go to the letters, numbers, and colors.

However, the comprehension power of each child is not the same. Here it can be seen from the creativity of the teacher to introduce students to the introduction of numbers and letters through the media.

With media in the form of pictures or games, it can even be combined with singing, being able to attract more real student interest and knowledge. Besides that, children must also be able to memorize numbers and sequences 1–10 and the colors on the uno card. This is the simplest thing to learn.

Qualified, quality education can be achieved by implementing an effective and efficient teaching and learning process. Learning achievement can be grouped into learning achievement in all fields of study and learning achievement in certain fields. To get achievement results for students, surely the teacher will carry out a system of approaches to hopefully gain a broader and deeper understanding. Based on this, the basic learning achievement of numbers, colors, and thematics through role play will be able to obtain student results, which should tend to increase in achieving these expectations or at least be maintained. Thus, it is hoped that students will absorb the basic learning materials for numbers, colors, and thematics as much as possible through role play learning achievement indicators at the kindergarten level.

1.1 The Nature of Learning and Learning Outcomes

According to Rusmono [1], learning outcomes are changes in individual behavior that include the cognitive, affective, and psychomotor domains. We can interpret this change as an improvement and also a better development, where previously those who did not know will become aware.

Bloom mentions (in Rusman [2]) that the changes that occur in learning are learning outcomes, which include changes in the cognitive, affective, and psychomotor domains. The cognitive domain is knowledge, understanding, application, analysis, and evaluation. The affective domain is the attitude toward receiving, responding, assessing, managing, and living. The psychomotor domain includes movement and acting skills, as well as verbal and non-verbal expression skills.

1.2 The Nature of the Role-Play Learning Model

Helmiati [3] states that the learning model is a description that is formed or presented by educators in a lesson; the learning model is a frame (frame) of the application of approaches, models, strategies, and learning techniques. Meanwhile, according to Suprihatiningrum [4], the learning model is a systematic procedure regarding learning patterns in order to achieve learning objectives carried out by students by instilling values and knowledge in them. According to Trianto [5], the learning model is a design or guideline used in designing the learning process that is implemented and determines learning tools consisting of books, films, computers, curricula, and others.

Prastowo [6] emphasized that the learning model is a reference for learning activities that are carried out or applied based on patterns that are composed of students' skills, ideas, and ways of thinking. Based on the opinions of the experts above, it can be said that the learning model is a systematic pattern that is compiled and developed by students in order to achieve a desired learning goal. Patterns or ideas determined by students must be in accordance with learning objectives because they are directly related to cognitive, affective, and psychomotor learners. The application of learning models that are always varied and creative will generate interest and motivation to learn in children, so that the results will increase their learning competence.

According to Slavin (Isjoni [8]), a cooperative learning strategy is a learning model in which students learn and work in small groups collaboratively with 4-6 members with heterogeneous group structures. Researchers apply this group learning strategy, because students in groups will work together and exchange opinions on understanding teaching material. Bruce Joyce et al. (in Johnson [9]). Fannie and George Shaftel stated that in role-playing, students explored problems concerning human relations by playing roles in problem situations and then discussing the rules.

According to Sugihartono [10], Model role playing is a learning model through which students develop their imagination and appreciation by playing characters, both living and dead, so that they practice appreciation and are skilled at using the material being studied. According to Gagne and Briggs [11], learning is a system that aims to assist student learning

processes and contains a series of events that are designed and arranged in such a way as to influence and support the internal student learning process. Meanwhile, Sagala [12] explains that the role-playing model is a way of presenting learning material by demonstrating and acting out the ways of behavior in social relations. In its implementation, students get assignments from the teacher to play a social situation that contains a problem so that they can solve a problem that arises from a social situation.

1.3 UNO Card Media

Media comes from Latin, which is the plural form of "Medium" which literally means "Intermediary" or "Introduction", namely an intermediary or introduction to the source of the message with the recipient of the message. Gagne and Briggs (in Arsyad [13]) explicitly say that learning media include tools that are physically used to convey the content of teaching materials. From these two definitions, media is a tool used to convey learning material. According to Heinich and Friends [14], Arsyad [15] put forward the term medium as an intermediary that conveys information between sources and recipients. This definition emphasizes the term media as an intermediary. In the Instructional Technology and Media for Learning Book (Sharon E. Smaldino and James D. Russell). Media is the plural of medium, which means a means of communication. This term refers to something that carries information between a source and a recipient. The six basic categories of media are text, audio, visual, video, manipulative (objects), and people (technicians). The purpose of the media is to facilitate communication and learning.

Media comes from the Latin word medium, which means "between." This term refers to anything that carries information between a source and a receiver. According to Sanjaya [16], media is a tool and a source, and although its function is as a tool, it has a role that is no less important. In connection with this study, the media used were handouts and scripts. Gagne states that the media are various types of components in the student's environment that can stimulate them to learn, whereas Briggs argues that the media are all physical tools that can present messages and stimulate students to learn [17].

Gagne & Briggs in Arsyad [18] argue that learning media include tools that are physically used to convey the content of learning materials, consisting of, among others: books, tape-recorders, cassettes, video cameras, video recorders, films, slides (picture frames), photos, pictures, graphics, television, and computers.

Uno is a card game for two to twelve players. The object of the game is to get rid of all the opponent's cards faster than all the other players by throwing them in the middle of the table. Instead of taking turns, all players play simultaneously. The game in its present form, was published in 1988 by Rosengarten Spiele (Rose Garden Games), Germany, and designed by Michael Michaels. Early forms of the game were published in the early 1960s. Since 2000, the game has been published by Schmidt-Spiele from Berlin, Germany. In 2009, Playroom Entertainment began publishing games for North America and other English-speaking countries. The game is similar to Dutch Blitz, which is based on the original 1960s Uno. Both Uno and Dutch Blitz use specially printed cards but feature nearly identical games to Nerts, which is played with standard playing cards and is in turn based on Canfield, a variant of the classic Klondike Solitaire.

This game uses a lot of special cards. Each card is colored red, green, yellow, or blue, and is numbered from 1 to 10. Each player gets 40 cards (ten of each color) that have a different design on the back that is unique to that player.

1.4 The Nature of Developing a Role Play Model Through the UNO Card

Development is a type of research that we are more familiar with under the term research and development (R&D). Development research is research that aims to use research to produce certain products and test the effectiveness of relatively new types of research. The definition of development research according to Borg & Gall is "a process used to develop and validate educational products". Meanwhile, according to Seels & Richey, "development research is a systematic study to design, develop, and evaluate programs, processes, and

learning outcomes that must meet internal consistency and effectiveness criteria. This development research follows the steps in a cycle. The steps of this research or development process consist of a study of the research findings for the product to be developed. Developing products based on these findings, conducting field trials according to the setting where the product will be used, and revising the results of field trials.

The research procedures (R&D) that have been carried out are described by identifying systematic stages in developing learning. Uno Media Card Game: Learning Media is basically a physical tool that can provide information through message channels and stimulate students to learn. Learning media is a form of communication tool, both printed and audiovisual. These components include the existence of players, the environment where players can interact, the rules of the game, and the goals to be achieved. After the four components are complete, the game can begin.

Figure 1. Display of UNO cards and UNO card games in learning Colors and Numbers for Tri Sakti Lubuk Pakam Kindergarten students

The research problem is formulated as follows: (1) Is the role play model development through uno cards appropriate for use at the kindergarten level? (2) Is the role play model effective in teaching numbers and colors at the kindergarten level? (3) Are there differences in student learning outcomes in learning numbers and colors using the role play model?

2. METHOD

This type of research is a type of development research, commonly called development (Research and Development). Research development is research that aims to produce a product through the development process [19]. According to Sugiyono [20], research and development are both research that produces products and other activities, namely testing the effectiveness of the products to be produced. In order to be able to produce a particular product, namely research that needs analysis in nature and to test the effectiveness of the product so that it can function for a large audience, research must be carried out to test the effectiveness of the product that has been produced. R & D can be defined as a research method that is deliberately, systematically, aimed or directed at finding, formulating, improving, developing, producing, and testing the effectiveness of products, models, methods, strategies, means, services, and certain procedures that are superior, new, effective, efficient, productive, and meaningful. Neuman [21] stated that development research in learning is a process used to develop and validate the products used in the learning process.

In the ADDIE model, there are several stages, namely: analysis, Design, Development, implementation, and Evaluation. The following are products with the ADDIE model:
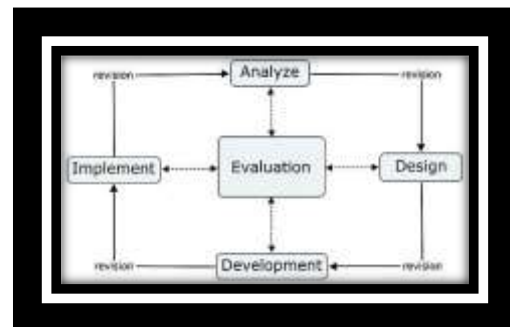

Figure 1. Stages of the ADDIE Model

In this study, models and development procedures were used with the ADDIE model as previously stated for each stage: analysis, design, development, implementation, and evaluation, based on what was stated by Branch [22], namely: Analyze, Design, Development, Implementation, and Evaluation.

This research was conducted in Kindergarten at Tri Sakti Lubuk Pakam School. A total of 60 students. The sample in this study was 60 kindergarten students. Sampling was done randomly. Tri Sakti Kindergarten Lubuk Pakam odd semester 2023/2023 The attractiveness of the product effectiveness data is known through the results of the analysis of trial activities carried out through several stages, namely: (1) Review by material experts, media experts, and design experts; and (2) field trials.

The main aspect that forms the basis for testing the hypothesis in this learning activity research is the average score of learning activities obtained from the implementation of learning in the control and experimental classes. Hypothesis testing is carried

out using the Independent Sample T-test, with the assumption that the results of the analysis prerequisite test are normal and homogeneous. However, if the prerequisite test results are not normally distributed, a test is performed using the Mann-Whitney test.

Interpretation of the results was tested at the significance level (p) of 0.05. The hypothesis in this study of learning activity data is as follows:
Ho1: There is no difference between the experimental class using the Uno card-assisted role play model and the control class using the conventional learning model for kindergarten students at Tri Sakti Lubuk Pakam.
Ha1: There are differences in learning activities for numbers, sequences, and colors in the experimental class using the Uno card-assisted role play model and the control class using conventional learning models for Tri Sakti Lubuk Pakam Kindergarten students.
Furthermore, Hake in Mchunu & Imenda [23] classifies this increase in gain into several levels of interpretation. The normalized gain index can be seen in Table 1 below.

Table 1. Index of Normalized Gain Value (N-Gain)

Gain Value	Interpretation
g ≥ 0.70	High
0,70 > g ≥ 0,30	Medium
g < 0,30	Low

Source: Adapted from Hake (Mchunu & Imenda, 2015)

3. RESULTS AND DISCUSSION
3.1 RESULTS
The results of the assessment by media experts, material experts, individual trials, small group trials and limited field trials for all aspects of the assessment are determined by the average score. The results of the assessment are then analyzed and determined whether or not it is appropriate to develop interactive multimedia-based learning media. The average percentage of the results of the assessment of media experts, material experts, individual trials, small group trials and field trials is shown in Table 2 below:

Table 2. Feasibility of CTL-based interactive media

No	Categorization	ercentage of average score %	Criteria
1.	Material Expert Validation	88,24	very feasible
2.	Model Expert Validation	95,56	very feasible
3.	Learning Design Validation	95,00	very feasible
4.	Limited Field Testing	83,70	very feasible
The average		90,62	very feasible

Based on Table 2, it can be concluded that the scoring intervals for material expert validation, media expert validation, learning design validation, limited field trials show an average of 90.62% with very feasible criteria. So the application of the role play model through UNO cards is very feasible and appropriate to learn.

Descriptive Research Data. Based on the data obtained from the results of the study with a sample of 60 students, the average and standard deviation of the results of the literacy skills of the control class and experimental class students were obtained as shown in Table 3.

Table 3. Descriptive Research Data

Control Class		Experiment Class	
Average	SD	Average	SD
67,69	7,95	85,4	3,61

From the data in Table 3, it can be seen that in the control class that has carried out learning, the average student score is 67.69 with a standard deviation of 7.95. Meanwhile, in the experimental class, the average student score was 85.4 with a standard deviation of 3.61. Based on Table 4.10 it can be seen the difference between the control class and the experimental class.

Table 4. The difference in the average score of learning outcomes

Information	Literacy Ability Average Score
Control Class	67,69
Experimental Class	85,4
Difference Score	17,71

Based on Table 4 above, it can be seen that the sample learning outcomes have increased with a difference of 17.71%. For more details, the description of the score data on learning outcomes in the experimental class and control class will be described in the following research results.

Assessment of Control Class Students
Based on the data obtained, the highest score is 85 and the lowest is 52.5 with an average (M) = 67.96 and a standard deviation (Sd) = 7.95. In Table 4.54 it can be seen the distribution of the frequency of scores of students who do not use the learning model (control class) on the subject of knowing numbers.

Table 5. Frequency distribution of control class student assessments

Class No	Interval Class	Frequency	%
1	50-55	2	6,67
2	56-61	4	13,33
3	62-67	8	26,67
4	68-73	9	30,00
5	74-79	5	16,67
6	81-86	2	6,67
Total		30	100

In Table 5 it can be seen that the score of the frequency distribution of the post test learning outcomes of students who did not use the learning model (control class) in learning to recognize numbers was in the 50-55 interval class as much as 6.67 percent, the 56-61 interval class as much as 13.33 percent and the 62-67 class interval as much as 26.67 percent, then the 68-73 interval class as much as 30 percent, the 74-79 interval class as much as 16.67 percent and the 81-86 class interval as much as 6.67 percent.

Assessment of Experimental Class Students

Based on the data obtained, the highest score is 95 and the lowest is 77.5 with an average (M) = 85.4 and a standard deviation (Sd) = 3.61. In Table 4.12 it can be seen the frequency distribution of student scores using the learning model (experimental class)

Table 6. Distribution of the Frequency of Assessment of Experiment Class Students

Class No	Interval Class	Frequency	%
1	77,5-79,5	2	6,67
2	80,5-82,6	5	16,67
3	83,5-85,5	11	36,67
4	86,5-88,5	7	23,33
5	89,5-91,5	4	13,33
6	92,5-94,5	1	3,33
Total		30	100

In Table 6 it can be seen that the score of the frequency distribution of post test learning outcomes of students using the learning model (experimental class) is in the 77.5-79.5 class interval of 6.67 percent, the 80.5-82.5 class interval is 16.67 percent and the 83.5-85.5 class is 36.67 percent, then the 86.5-88.5 class interval is 23.33 percent, the interval class is 89.5-91.5 13.33 percent and class interval 92.5-94.5 as much as 3.33 percent.

The level of tendency of the research variable is determined by using student assessment research data. Then it can be identified the level of tendency to score the results of the control class literacy ability in Table 7 below:

Table 7 Level of Trend in the Control Class

Information	F. absolute	F. relative	Category
>74,37	7	23,33	Very good
68,75-74,37	8	26,67	Good
63,12 – 68,75	6	20,00	Fairly good
<63,12	9	30,00	Not good
Total	30	100	

Based on Table 7, it can be seen that the level of tendency for student learning outcomes in the control class was only 23.33 percent in the very good category, then 26.67 percent in the good category and 20.00 percent in the fairly good category. Then 30.00% in the unfavorable category. Thus the one with the highest percentage is the unfavorable category, so it can be concluded that the level of tendency in the control class is in the unfavorable category.

The trend level of research variables is determined using posttest research data. Then it can be identified the level of tendency in the assessment of experimental class students in Table 8 below

Table 8 Level of Tendency in the Experimental Class

Information	F. absolute	F. relative	Category
>90,61	5	16,67	Very good
86,20-90,61	11	36,67	Good
81,89 – 86,20	7	23,33	Fairly good
<81,89	7	23,33	Not good
Total	30	100	

Based on Table 8, it can be seen that the level of trend in experimental class student learning outcomes was obtained by 16.67 percent in the very good category, then 36.67 percent in the good category and 23.33 percent in the fairly good category. Then 23.33% in the less good category. Thus, the category that has the highest percentage is quite good, so it can be concluded that the level of tendency in the experimental class is in the good category.

This Normality Test is used to determine whether the research data is normally distributed or not. The test was carried out using the chi square test for both groups as described in Appendix 13. The results of the calculation of the chi square test obtained samples from populations that were normally distributed, because χ^2count < χ^2Table at the significance level $\alpha = 0.05$.

Based on Table 4.15, the results of the assessment of students who did not use the model (control class) were (χ^2count = 4.35) and (χ^2Table = 11.070) at a significant level of 5 percent, so that (χ^2count = 4.35 < χ^2Table = 11.070) so that it can be concluded that the distribution of data from the assessment results of students who did not use the model (control class) is normally distributed.
Furthermore, the learning outcomes of students who use the learning model (experimental class) are (χ^2count = 3.09) and (χ^2Table = 11.070) at a significant level of 5 percent, so that (χ^2count = 3.09 < χ^2Table = 11.070) so that it can be concluded that the distribution of data on student learning outcomes using the learning model (experimental class) is normally distributed.

Table 9 Normality Test Results

Class	χ^2count	χ^2Table	Conclusion
Learning outcomes of students who do not use the role play model through uno cards	4,35	11,070	Normal
Student learning outcomes using the role play model through uno cards	3,09	11,070	Normal

The homogeneity test is intended to determine differences in the variance of the data for each class. To determine the homogeneity of the assessment results using the Barlett test presented in Table 10.

Table 10 Homogeneity Test

Class	χ^2count	χ^2Table	Conclusion
Learning outcomes of students who do not use the role play model through uno cards	5,33	7,81	Homogeneous
Student learning outcomes using the role play model through uno cards			

From Table 10 above it is known that after the F test was carried out on the data on the results of the control class students and the experimental class, it was obtained Fcount = 5.33 and

FTabel = 7.81 at a significance level of 0.05 with dk = 2-1 = 2. The results of the calculation above stated that Fcount < FTabel which means that the scoring results of students in the control class and the experimental class, have a homogeneous variance, which means that the sample from each treatment group in this study has the same empirical character of the problems studied.

Test the Feasibility of the Product Developed. Testing the feasibility of the product developed was analyzed from the feasibility validation from experts and the feasibility of testing it on students. The results of the expert feasibility validation trial can be presented in Table 11.

Table 11. Expert Feasibility Validation Test Results

No	Expert Assessment	Percentage	Criteria
1.	Learning Material Expert	88,24%	Very Good
2.	Expert Learning Model	95,56%	Very Good
3.	Learning Design Expert	95%	Very Good
4.	Field Trials	83,7 %	Very Good
	Average	90,63%	Very Good

Based on Table 11 above, it can be seen that the average rating (μo) from experts and field trials is 90.63%, while the eligibility threshold value criteria (μ) is 70%, then $\mu o > \mu$ mapka can be concluded that the role play model product through the Uno cards developed includes very good criteria, which means that the product is very feasible to use and can meet the needs of implementing number recognition learning.

N-Gain Score test results To test the ability of the role play learning model through Uno cards in improving learning outcomes, the N-Gain effectiveness formula is used. The normalized gain test (N-Gain) is calculated in order to see an increase in student learning outcomes after being given treatment. The results of calculating the n-gain score in this study are presented in Table 12 below:

Table 12 N-Gain Score Results

Sample	Ideal Score (100-Pre)	N-Gain Score	N-Gain Score (%)
The learning outcomes of posttest students who do not use the role play model through uno cards (control class)	36,52	0,36	36%
Posttest student learning outcomes using the role play model through Uno cards (experimental class)	43,30	0,73	73%

Based on Table 12 above, it can be concluded that the use of the role play model through uno cards can improve student learning outcomes with a percentage of 73% in the high category.

Hypothesis Test of Product Effectiveness Developed. The results of the product effectiveness hypothesis test are known through the difference in assessment of the control and experimental class students. It can be seen that the results of the following hypothesis test calculations are presented in Table 13.

Table 13. Hypothesis Test Calculation Results

Statistics	Class	
	Control	Experiment
N	30	30
Means	68	85
Sd	8,13	4,22
S^2	66,10	17,82
t_{count}	10,691	
t_{Table}	1,167	
Status	H_a accepted	

Based on Table 13 above, the value of t count = 10.691 is obtained. At the significant level ($\alpha = 0.05$) and dk = n1 + n2 – 2 = 58, it is known that the level (0.05; 58) is 1.167, so the price of tcount compared to ttable turns out to be tcount > ttable, namely (10.691> 1.167). Then Ha is accepted so that it can be concluded that the role play learning model through Uno cards in learning to recognize numbers for Tri Sakti Lubuk Pakam Kindergarten students is appropriate to use and has a higher effectiveness than the previous learning model in terms of assessing learning outcomes.

Based on the research conducted, it was found that student ratings in the experimental class that used the role play model through the UNO card were in the good category of 36.67%, while in the control class, which did not use role play through the UNO card (Control), there was a tendency of 26.67% in the unfavorable category.

3.2 DISCUSSION
Furthermore, for the percentage of expert validation test results on role play models through Uno cards, it is known that the percentage of subject matter aspects is 88.24% in the very good category, the average assessment of the model aspect is 95.56%, the learning design aspect is 95% in the very good category, and field trials are 83.7% in the very good category. All aspects of the assessment with an average of 90.63% in a very good category.

In line with Agarwal's research [24] concerning the use of Multimedia as a New Educational Technology tool: a study. The results of the study suggest that multimedia can provide a better quality learning process. Taking into account pedagogical interests, the use of media is the main potential for maximizing the process of achieving learning objectives.

The results of the analysis of the assessment data for the control class that did not use the role play model through Uno cards can be stated that the average score of learning outcomes was 68.00 and the experimental class that used flipbook-based e-books was 85.00 with classical completeness of 100%.

Sadiman [25] argues that the learning model is a method that can be used to channel messages from the sender to the recipient so that it can stimulate thoughts, feelings, concerns, and interests as well as students' attention in such a way that the learning process occurs. The media also has related software containing educational messages, which are usually presented using equipment.

Kemp and Dayton in Kustandi [26] argue that the learning model can fulfill three main functions when the media is used for individuals, groups, or large groups, namely in terms of: (1) motivating interest or action; (2) presenting information; and (3) giving instructions. To fulfill the motivational function, learning media can be realized with drama or entertainment techniques.

Based on some of the opinions and research results stated above, it can be concluded that the role of the teacher will be very influential in helping and determining the success of their students. The teacher is the main actor as a facilitator of the implementation of the learning process. The teacher's task is to convey subject matter to students through communication in the teaching and learning process carried out at school. Therefore, the success of a teacher in conveying subject matter to students also depends on the learning media he uses. Because the non-fluency of the use of learning media can have bad consequences for the message to be conveyed by the teacher.

4. CONCLUSION

After carrying out the process or stages of developing the role play learning model through the Uno card, the following conclusions can be put forward:

1. The role play learning model through Uno cards used in number recognition material at Tri Sakti Lubuk Pakam Kindergarten is appropriate to use.
2. The role play learning model through Uno cards used in number recognition material at Tri Sakti Lubuk Pakam Kindergarten is effectively used.

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Development Of Interactive Digital Big Book History of North Sumatra as A Source of Learning for History Education Students on the MBKM Curriculum

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Abstract: The importance of developing an interactive digital ledger of the history of North Sumatra which is open access for students of history majors/study programs as a learning resource is the main background for the implementation of this research. In addition, to respond to government programs, especially in the world of education with the implementation of the Merdeka Learning Campus Independent curriculum, and to answer the challenges of education in the Industrial Revolution Era 4.0. Lecturers and students in their learning, especially the History of North Sumatra course, tend to use printed books whose content is less relevant to Graduate Learning Outcomes and Learning Outcomes Department of History Education Faculty of Social Sciences UNIMED. This condition is due to the existence of printed books that currently contain limited material about the geographical, economic, and socio-cultural conditions of several regions of North Sumatra with a time limit of only the 20th century. Studies on the existence of figures and the development of art by artists, especially composers, especially musicians and composers, such as Liberty Manik with the national anthem Satu Nusa Satu Bangsa, for example, are almost untouched. Therefore, the use of the interactive digital-based History of North Sumatra ledger will greatly facilitate students in exploring learning resources in the form of digital, multimedia such as audio, video, animation, photos, graphics, and so on, especially in the current era of the covid-19 pandemic. In addition, the digital application will give students access to other sources such as historical archives from sites such as the National Library, KITLV, and the Indonesian National Archives, to the acquisition of the latest scientific articles through national and international links available on digital applications. Therefore, research on the development of an interactive digital ledger of the History of North Sumatra is very important to do.

Keywords: Big Book, Interactive, Local History

1. INTRODUCTION

Based on Permendikbud No. 3 of 2020 which states that every higher education institution (PT) is obliged to facilitate students in strengthening competence by providing opportunities for learning outside the study program at the same university and taking learning in the same study program at a different university, therefore The MBKM curriculum is one of the strategic policies of the Ministry of Education and Culture in improving the quality of Indonesian human resources through higher education in facing global challenges [1]. In addition, RI Government Regulation Number 4 of 2022 concerning National Education Standards, article 6 point (4) c states, Graduate competency standards in higher education units are focused on knowledge, skills, independence, and attitudes to discover, develop, and apply science, technology, and art, which are beneficial to humanity, the State University of Medan (Unimed) as an accredited A PT (SK BAN-PT No. 2988/SK/BAN-PT/Akred/PT/XII/2016) responded, by participating in opening the most comprehensive opportunity for students to implement these policies through several programs such as student exchanges through Permata Sakti, Permata Sari, Internships, and so on. This Government Regulation and Ministry of Education Program also provide incentives to maximize distance learning to accommodate the needs of MBKM in conducting online lectures. The use of learning platforms by Unimed such as SIPDA, GAFE (Google Application For Education), Zoom, and others, will greatly assist lecturers and students in distance learning activities, especially in this pandemic era [2].

To maximize classical and distance learning in the MBKM program, in addition to using the learning platform provided by Unimed, lecturers of course need to develop digital-based learning materials as an alternative to printed teaching materials, because they can enrich teaching materials/materials through multimedia facilities such as audio, video. , animations, photos, graphics, journal web links, and so on. This makes it possible for students to obtain digital applications as learning resources with smartphones based on Android and iOS through Google Play and the App Store, so that classical, blended, distance learning or full online history learning can run more effectively, flexibly, and efficiently. Interactive digital-based teaching materials as learning resources are still rare in the UNIMED FIS environment, especially JPS.

The Department of History Education is one of the four majors/study programs in the FIS environment that is accredited A (SKBAN-PT No. 9574/SK.BAN-PT/Ak-PPJ/S/VII/2021) responding to the MBKM program by the

Rector's Regulation No. . 0362/UN33/PRT/2020 concerning Freedom of Learning, which requires every Lecturer to be able to develop learning activities, both offline, blended learning, and fully online [3]. This is a mandatory solution for implementing distance learning as a result of the covid-19 pandemic and as an adaptation to facing the challenges of the Industrial Revolution 4.0 in the world of education, as well as the realization of the MBKM curriculum. North Sumatra History Course is one of the courses launched by JPS. as a subject in the independent learning program that is taken not only by JPS FIS UNIMED students but also by students who join from other universities. To maximize learning in lectures, it is necessary to develop teaching materials using digital-based learning resource applications. This is done to be able to access teaching materials/materials easily through the use of smartphones by students who attend North Sumatra History lectures either offline, blended learning, or fully online [4].

One of the big obstacles faced in lectures at JPS FIS UNIMED in the RI 4.0 era and the MBKM curriculum was the absence of digital ledgers that were up to date and relevant to the CPL-CPMK, especially for the class of courses called spatial history such as Indonesian history, Sumatran history. North, American History, European History, African History, Asian History, and other spatial history courses. The big book available in the market today and which is considered the most complete for the study of North Sumatra is the work of William Marsden, History of Sumatra, published in 1966 by Oxford University, translated and published by Komunitas Bambu in 2008. in the historical study of the 20th century, precisely in 1950 (not up to date), and relatively limited because it does not specifically discuss North Sumatra, and is not by CPL and CPMK in the MBKM Curriculum which has been formulated by the JPS Lecturer Team so that the teaching materials are not can meet the needs of Lecturers and Students, and result in CPL-CPMK far from expectations.

The description above shows how important the digital-based ledger or the interactive digital North Sumatra History Ledger is to help optimize the competence of JPS students in mastering the materials in special courses, especially the History of North Sumatra so that each CPL-CPMK that has been formulated can be achieved. Therefore, research on the development of digital teaching materials in the form of interactive applications can be a novelty and something very important to be carried out to answer the challenges of Higher Education in the RI 4.0 Era and Independent Learning to welcome UNIMED to become The World Class University.

2. METHOD

The method used in this research is the research and development method. Development research method is a method used to produce certain products, and test the effectiveness of these products (Sugiyono, 2010:407). Research and Development is a process or steps to develop a product or improve existing products, which can be accounted for [5].

The process of developing this interactive digital-based North Sumatra History Ledger Application uses the research and development (R&D) model by Borg and Gall [6]. The stages of the R&D development model include: a) the needs analysis stage, consisting of student analysis, material analysis,

and goal specification; b) the design phase of teaching materials products, including the selection of teaching materials, and initial design; c) the production/implementation stage of initial product development, including the manufacture of teaching materials, and the preparation of assessment instruments (validation sheets, questionnaires/questionnaires; d) the validation stage, including assessments from design experts (Historical Education Lecturers), and assessments from material experts (History Education Lecturer); e) the revision stage, which includes revisions or improvements to the media based on suggestions by the validators; f) the product trial phase, including testing the material on students, filling out questionnaires by students and carrying out learning outcomes tests; g) the final revision and dissemination stage, including the analysis of the success of the media and the final improvement or revision of the media as well as the dissemination of the media. The last step in this research is the effectiveness test [7].

3. RESEARCH RESULT

Analysis Stage

The development of this media begins with analyzing some of the necessary needs. These needs include: material selection and user determination, to be used as a reference in the development of the North Sumatra History Ledger.

1) User (user)

The target users of the North Sumatran History Ledger Application developed are students of the Department of History Education at the Faculty of Social Sciences, State University of Medan. Based on interviews with several students, it is shown that learning using mobile devices (smartphones) is very interesting for them and can help students learn independently whenever and wherever. Based on a preliminary study conducted by researchers through observations and interviews, data obtained that the average student has an Android smartphone which of course can access the North Sumatran History Ledger that will be developed [8].

2) Material Needs

The content referred to in this case is learning material for the North Sumatra History course. Several learning topics that have been prepared by the researcher are then shown to students, then the researcher conducts interviews. Students were asked to give their opinion on how important these topics were to them based on the needs they encountered in the lectures. The question that the researcher asked was about how important the topics that had been prepared were studied to develop students' abilities in the North Sumatra History course.

Furthermore, for the learning materials needed by students to be displayed in the North Sumatra History Ledger application. Researchers obtained data that the average student considers that audio and video media are very important media in learning Research Methods [9].

So to annul the needs of students, researchers will include several additional features such as practice questions and videos related to the Indonesian History course. The video presented is a video about phenomena or symptoms related to

the subject matter of the Indonesian History Course which will then be used as material for student projects in that course.

a. Product Design Phase (Design)

The product design of the North Sumatra History Book Application in this study was divided into two parts, namely the development of project-based research method teaching materials and the development of the North Sumatra History Ledger Application for Android-based research method teaching materials.

Initial Design of North Sumatra History Ledger Application Products

After the analysis and creation of project-based learning textbooks, the next stage is to design a product in the form of the North Sumatra History Ledger Application [10]. The initial design of the North Sumatran History Ledger application product based on Android is divided into 2 designs, namely the design for the front-end, namely the design for users (students who take Indonesian History courses) and the back-end design, namely the design design for administrators, namely lecturers so that at any time time can update the North Sumatran History Ledger Application that was developed.

Display Design of the North Sumatra History Ledger Application

a) Initial Screen of Application

The initial view of the application (login) is the view after the application is accessed by the user. In the display there are two fields that must be filled in by the user, namely the user name and password. Students who are registered as participants in the Research Methods course will be given a password by the lecturer who also acts as an admin on this North Sumatra History Ledger application.

b) Front View Design

The front screen is the display that appears after the student has passed the Login stage. On the front screen you will see a menu. In the first menu "About" is a menu that displays about the North Sumatran History Ledger Application product, the second menu "Material" is a menu that contains materials and sub-materials that will be discussed in lecture activities, the third menu "6 assignments" is a menu that will displays the 6 KKNI task sub menu items. The fourth menu is the RPS menu.

c) Display Design "Home"

The "Home" menu is a menu that contains matters relating to the North Sumatra History Ledger Application, such as; 1) The name of the North Sumatran History Ledger Application, 2) the purpose of the North Sumatran History Ledger Application, 3) how to use the North Sumatran History Ledger Application [11].

d) Material Display Design contained in the "Home" sub menu

The material menu is a display in which there are various kinds of material that are in accordance with the teaching materials in the online version of the Indonesian History course, both in written form and in the form of images and videos [12]. This menu also contains RPS (Semester Learning Plan) and powerpoint slides that can be downloaded by students.

e) 6 Task Display Design

In addition to supporting the blended learning model, the North Sumatra History Ledger Application is also designed to support 6 tasks determined by the KKNI curriculum applicable at Medan State University [13]. On the 6 task menu there is a detailed explanation display of 6 tasks that students must do. The display design is shown in Figure below.

Product Development Phase (Development)

The development stage is the stage of making the North Sumatran History Ledger Application. In making this North Sumatra History Ledger Application, it was adjusted to the design design. First, the collection of materials used to fill in the content in this North Sumatra History Ledger Application such as images, videos, and animations is carried out. These materials are obtained by using electronic books, google and youtube [14].

After all the materials have been collected, the next step is to make the North Sumatran History Ledger Application, the Android version of the North Sumatra History Ledger Application, using the Sigli software.

Implementation Stage

The implementation phase contains product trials that have been developed to a number of respondents. In the implementation, the researcher makes a learning scenario using the Blended Learning model. The implementation of blended learning consisted of 4 meetings, namely 2 face-to-face meetings and 2 online meetings using Zoom and Dandroid web meetings for Indonesian History lectures. During the trial, the researcher asked 2 experts, namely the learning media expert and the material expert to provide an assessment of the North Sumatra History Ledger Application product [15].

1) Expert Validation

Before the product was used, the researcher asked for the assessment of the Research Methods Material Expert and the Digital-based Learning Media Expert. The assessments of the three experts are as follows:

(a) Media Expert Assessment Results

Media experts are respondents who are considered to have a good or bad assessment of a learning media. This North Sumatra History Ledger application was tested by 1 digital learning media expert who assessed the software engineering and visual communication side.

The results of the media assessment recap are shown in Table 5.1 below:

No	Item	Skor
1	Deskripsi Aplikasi Buku Besar Sejarah Sumut jelas	4,00
2	Panduan penggunaan Aplikasi Buku Besar Sejarah Sumut mudah dipahami	4,50
3	Tampilan sampul Aplikasi Buku Besar Sejarah Sumut	4,00
4	Aplikasi Buku Besar Sejarah Sumut tidak memakan banyak memori	3,50
5	Proses loading media video dan Gambar berjalan dengan baik	4,00
6	Tampilan layout Aplikasi Buku Besar Sejarah Sumut menarik	4,00
7	Komposisi dan desain warna yang digunakan menarik	4,00
8	Tampilan desain, ukuran, dan tata letak icon tepat	4,50
9	kenyisimbol yang memudahkan pengguna dalam menggunakan media	4,50
10	Like audio dalam Aplikasi Buku Besar Sejarah Sumut berjalan dengan baik	4,50
11	Video pembelajaran berjalan dengan baik	4,50
12	Aplikasi Buku Besar Sejarah Sumut dapat dijalankan diberbagai versi android	4,00
13	Penggunaan jenis dan ukuran font sudah tepat	4,50
14	Penggunaan efek dan tampilan antarmuka pada Aplikasi Buku Besar Sejarah Sumut sederhana dan menarik	4,00
15	Aplikasi Buku Besar Sejarah Sumut bisa digunakan kapan saja dan dimana saja	4,50
16	Desain tampilan sesuai dengan tingkatan pengguna	3,50
17	Kemudahan dan kesederhanaan dalam pengoperasian	3,50
18	Bahasa yang digunakan mudah dipahami	4,50
19	Konsistensi penempatan media gambar dan video	3,50
20	Ketepatan antara background dan warna huruf	4,50
Jumlah total		82,50
Rata-rata		4,10
Kriteria	Sangat Layak	

In the assessment questionnaire above, we can see that media experts gave very good ratings for all items with a total of 82.50 with an average score of 4.10. Based on the total and average values, it can be concluded that the Android North Sumatra History Ledger Application "History of Indonesia" is suitable for use in learning with the blended model.

(b) Material Expert Assessment Results

Material experts are respondents who assess the feasibility of the material content contained in the developed North Sumatra History Ledger Application media. In this study, the material experts appointed by the author are experts who really understand how to design interesting learning based on materials and sub-materials in the Indonesian History course and have a scientific background related to learning Indonesian history and understand learning models. The results of the material assessment are shown in Table 5.2 below.

No	Item	Skor
1	Materi yang dimuat dalam Aplikasi Buku Besar Sejarah Sumut sesuai dengan kurikulum KKNI	5,00
2	Aplikasi Buku Besar Sejarah Sumut ini dapat menunjang tercapainya tujuan pembelajaran	4,00
3	Kesesuaian antara desain materi dan project based learning	5,00
4	Aplikasi Buku Besar Sejarah Sumut ini dapat membuat peserta didik tertarik untuk lebih mempelajari materi ajar	4,50
5	Materi yang dimuat dalam Aplikasi Buku Besar Sejarah Sumut sesuai dengan RPS mata kuliah Metode Penelitian	4,00
6	Aplikasi Buku Besar Sejarah Sumut dapat menambah keberanian mahasiswa untuk menggunakan Metode Penelitian.	4,50
7	Aplikasi Buku Besar Sejarah Sumut ini memungkinkan peserta didik untuk belajar secara mandiri	4,00
8	Keterbacaan kalimat dan paragraf jelas	4,50
9	Materi yang dimuat dalam Aplikasi Buku Besar Sejarah Sumut tersusun secara sistematis dan runtut	4,00
10	Vidio yang ditampilkan pada Aplikasi Buku Besar Sejarah Sumut dapat membantu peserta didik untuk memahami materi	4,00
11	Tautan video yang disajikan sesuai dengan materi	3,50
12	Mendorong peserta didik terlibat aktif	4,00
13	Latihan soal yang diberikan dalam Aplikasi Buku Besar Sejarah Sumut sudah sesuai dengan materi yang disajikan	4,50
14	Kesesuaian latihan soal dengan tujuan pembelajaran	4,00
15	Menggunakan istilah-istilah yang tepat dan mudah dipahami	4,50
16	Memberikan motivasi/minat dan rasa ingin tahu peserta didik	4,50
17	Materi up to date	4,50
18	Materi yang disajikan mengandung 4 kompetensi Metode Penelitian	4,50
19	Kesesuaian antara materi dan kebutuhan jurusan Bimbingan dan Konseling	4,50
20	Gambar-gambar yang digunakan pada Aplikasi Buku Besar Sejarah Sumut	4,00
Jumlah total		86
Rata-rata		4,3
Kriteria		Sangat Layak

In the assessment questionnaire above, we can see that the material expert also gives a very good assessment of the material that has been displayed by the researcher on the product. The results of the calculation for all items in the material assessment, namely as many as 20 assessment items, obtained a total of 86 with an average value of 4.30. Based on the total and average values, it can be concluded that the material contained in the Android North Sumatra History Ledger Application "History of Indonesia" based on Literacy Hots is suitable for use in learning [16].

2) Application of the North Sumatran History Ledger Application in Learning the History of North Sumatra

The application of the North Sumatran History Ledger for the Literacy Hots-based Research Methods course is the product developed in this research. Therefore, it is necessary to implement the use of the North Sumatran History Ledger Application in learning Indonesian History courses to find out how students respond and evaluate the products developed.

Student Interest in Android-Based Learning

To find out students' interest in learning the Research Methods course using the North Sumatran History Ledger Application based on Literacy Hots, students were asked to fill out a response questionnaire by giving an assessment of each indicator by putting a check mark ( ) on the range of numbers that are considered appropriate, namely (4) to strongly agree, (3) to agree, (2) to disagree, and (1) to disagree. The results of the questionnaire were then analyzed by calculating the percentage value obtained from each aspect, namely the total value of each aspect divided by the maximum number and multiplied by 100% as stated by Hariyadi (2009) in [17] as follows:

$$P = \frac{f}{N} x100\%$$

Keterangan:
P = Persentase
F = frekuensi yang sedang dicari atau skor yang diperoleh
N = *Number of cases* atau skor maksimal

Furthermore, to determine the response category given by students to an aspect by matching the percentage results with positive criteria according to Khabibah (2006) in Wulandari and Waryanto (2012), namely:

$85\% \leq$ respon = sangat positif (sangat tinggi)

$70\% \leq$ respon $< 85\%$ = positif (tinggi)

$50\% \leq$ respon $< 70\%$ = kurang positif (kurang tinggi) respon

$< 50\%$ = tidak positif (tidak tinggi)

Table 5.3 Results of Student Response Questionnaires

No	Aspek	Presentase	Kriteria
A	Perasaan Senang	87.15%	Sangat positif
B	Ketertarikan Terhadap Aplikasi Buku Besar Sejarah Sumut	86.57%	Sangat positif
C	Perhatian	85.83%	Sangat positif
D	Keterlibatan Mahasiswa	88.24%	Sangat positif

The results of the student response questionnaire obtained a percentage of 86.49% on aspects of feeling happy, 87.67% on aspects of student interest in using applications, 85.81% on aspects of attention, and 88.24% on aspects of student involvement. Looking at the four aspects, it shows a very positive student response, so it can be concluded that students have a high interest in learning using the developed North Sumatra History Ledger Application.

4. CONCLUSION

The developed North Sumatran History Book application can be one of the effective learning media for students and helps in learning the history of North Sumatra. The Hybrid Learning learning model will certainly be more effective when coupled with the use of the Ledger Application. In addition, the use of the North Sumatran History Ledger Application can stimulate students in developing a learning and independent culture and also increase students' Literacy Hots skills.

5. ACKNOWLEDGEMENTS

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Implementation of a Radio Frequency Identification (RFID) Based Cashless Vending Machine

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ABSTRACT: This paper reports the Implementation of a Radio Frequency Identification (RFID)-based multiproduct vending machine. It is designed to automatically dispense drinks such as coke, malt and yogurt using RFID prepaid method system. After a careful analysis of the existing system, noting its shortcomings, a new system was designed and developed such that the shortcomings of the old system were carefully overcome. The system was designed using Microcontroller (Arduino Mega board), RFID tag/card reader, servo, Liquid Crystal Display (LCD) and other electronic devices. A prototyping methodology was adopted and the machine parts (hardware and software) were designed in modules. These modules were then separately tested and found to be functioning as desired. They were then integrated to form the finished product. A C-language-based software that is able to drive a multiproduct vending machine was designed and implemented in this work and it made the hardware components function in a well-coordinated manner. The customer can buy a product using an RFID card by swiping the card across the RFID card reader, then the embedded system reduces the amount from the card, shows the balance on the LCD display, and the product which is stacked in the machine plunges out of each funnel inside the machine (this is controlled by a servo attached to the microcontroller) and accessed via the dispensing unit outlet. The vending machine developed in this thesis uses a PC as a guide to connect to the machine, especially for generating recharge codes. The RFID-based multiproduct vending machine was compared with the cash-based alternative and found to outperform it in terms of flexibility, efficiency, and security and has a better way of managing the financial return to the business due to the prepaid method of recharging the RFID card.

Keywords: LCD, Microcontroller, multiproduct vending machine, RFID-based Multiproduct.

1. INTRODUCTION

The vending machine is a coin-operated machine for selling merchandise (*Holcombe, 2017*). A vending machine is an automated machine that provides items such as snacks, beverages, cigarettes, and lottery tickets to consumers after money, a credit card, or a specially designed card is inserted into the machine. The first modern vending machines were developed in England in the early 1880s and dispensed postcards. Vending machines exist in many countries, and in more recent times, specialized vending machines that provide less common products compared to traditional vending machines have been created and provided to consumers.

A vending machine has two functions namely, selling of products and services to the customers. A vending machine sells the products that are installed into the body, each with its own different price. After paying, a product may become available by the machine releasing it at the bottom of the vending machine (Holcombe, 2017). For the vending machine that provides service as its main function, the service also may become available after payment is inserted. An example a of service vending machine is a Money ATM vending machine.

There are three techniques of payment used with vending machines. Many vending machines are capable of giving change, and some of the more modern ones accept paper money or credit cards. Vending machines may be classified according to the technique of payment as follows:

2. • Coin-operated vending machines.
3. • Note-operated vending machines.
4. • Prepaid operated vending machines.

There are three major problems with the payment method nowadays. That is a tank full of coins, the notes cannot be read and also the notes or coins are always stuck in the machine.

5. When the coin box is filled, no more coins can be accepted. When the tank is filled, no more coins can be accepted. This will mean that no more purchases can be made, thus vending machines will stop. Certain vending machines use a spiral kind of mechanism to separate and hold the products. When the machine vends, the spiral turns, thus pushing the product forward and falling down to be vented. If the products and the spiral are misaligned, the spiral may turn but not fully release the product (Kerry, 2002). The product will stick in the middle of the vending machine. The vending machine automatically will stop operation when this condition occurs.

Secondly, the problem related to the payment method is notes and coins cannot be read. For vending machines using notes as a method of payment, the notes must be in good condition. The term good condition refers to the good shape of the notes, not folded, and the original one. When using notes in bad condition such as crumpled and dirty, the vending machine cannot read the note and then rejected the payment. Also, some machines may not accept quarters and other coins.

Actually, when the coin or the notes inserted are not in the right direction, this problem will occur. The only way to remove the notes or coins stuck is to call the vending machine company to repair that machine. There is, also, the problem of using a coin of a foreign currency that has the same size and shape as the coin accepted by the machine to get cheaper merchandise and sometimes change that might have more value than the originally inserted foreign coin. Using different coins will make the vending machine have a problem with recognition and lastly the payment will stuck into the machine (Kerry, 2002). The first RFID application was the "Identification Friend or Foe" system (IFF) [Wiki-RFID]

[Wizard Wars] and it was used by the British in the Second World War. Transponders were placed into fighter planes and tanks, and reading units could query them to decide whether to attack. The successors of this technology are still used in armies around the world. The first commercial RFID application was "Electronic Article Surveillance" (EAS). It was developed in the seventies as a theft prevention system. It was based on tags that can store a single bit. That bit was read when the customer left the store and the system would sound alarm when the bit was not unset. In the end-seventies, RFID tags made their way into agriculture for example for animal tagging. In the eighties, RFID technology got a boost when Norway and several US states decided to use RFID for toll collection on roads [EZ-Pass]. In addition to toll collection, the following decade brought a vast number of new applications, such as ski passes, gasoline cards [Speed Pass], money cards, etc. In 1999 the Auto-ID Center at MIT was founded. Its task was to develop a global standard for item-level tagging. The Auto-ID was closed in 2003 after completing the work on the Electronic Product Code (EPC). At the same time, the newly founded EPC Global Inc. continues the work. The probably first paper related to RFID technology was the landmark paper by Harry Stockman, "Communication by Means of Reflected Power" in October 1948. The first patent on RFID was issued in 1973 for a passive radio transponder with memory [US. Patent 3,713,148]." (C Jechlitschek, 2006). This paper proposes the design of an intelligent RFID-based cashless vending machine for the sale of drinks. The proposed system is made up of a multi-select drinks machine with RFID based payment system. The user will swipe RFID payment Card on the machine and then select the drink he/she wants to buy. The card system includes the RFID which consists of an RFID reader and RFID tags. Using these tags drinks can be vented without human interaction or the involvement of fiscal cash. A prototyping methodology was used to achieve the software design aspect of the proposed system which considers the previous paying bills method for vending machines and makes payments by using coins or notes. C-language-based software that is able to drive a multiproduct Vending Machine was developed in the course of this paper; An RFID payment system was also incorporated to make the Vending Machine cashless in operation. When this RFID-based Vending Machine is compared with the cash-based alternative, it is noted that the RFID-based has outperformed the cash-based one in terms of efficiency, security, and sales tracking and it is, therefore, a better machine used for the sale of drinks.

2. LITERATURE REVIEW

Physical object identification has become increasingly more important as trade and transport markets have grown. The first automatic identifier for products which is still used on a large scale today was the barcode. Barcodes, however, have their flaws such as the need to align the barcode with the scanner and being able to only scan one product at a time. Better auto-ID systems have therefore been developed. A well-known auto-ID system that lacks the aforementioned flaws is radio frequency identification (RFID). RFID technology which uses radio waves in order to identify or track a small chip (RFID tag) that is attached to a physical object is envisioned as a replacement for its barcode counterpart.

An RFID device-frequently called an RFID tag is a small microchip designed for wireless data transmission. It is generally attached to an antenna in a package that resembles an ordinary adhesive sticker. The microchip itself can be as

small as a grain of sand, some 0.4mm2 (Juels, 2005). An RFID tag transmits data over the air in response to interrogation by an RFID reader. Advocates of RFID see it as a successor to the optical barcode familiarly printed on consumer products with two distinct advantages:

i. **Unique Identification:** A barcode indicates the type of objects on which it is printed e.g. "This is a 100g bar of ABC brand, 70% chocolate". An RFID tag goes a step further. It emits a unique serial number that distinguishes it among many millions of identically manufactured objects; it might indicate e.g. that "This is 100g bar of ABC brand, 70% chocolate, serial No: 897348738".

ii. **Automation:** Barcodes, being optically scanned require line-of-sight contact with readers and thus careful physical positioning of scanned objects. Barcode scanning requires human intervention. In contrast, RFID tags are readable without line-of-sight contact and without precise positioning. RFID readers can scan tags at rates of a hundred per second. For example, an RFID reader by a warehouse dock door can scan stacks of passing crates with high accuracy (Juels, 2005).

Radiofrequency identification (RFID) is the wireless use of electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information. Some types collect energy from the interrogating radio waves and act as a passive transponder.
Other types have a local power source such as a battery, and operate at hundreds of meters from the reader. Unlike a barcode, the tag does not necessarily need to be within the line of sight of the reader and may be embedded in the tracked object. Radiofrequency identification is one method for Automatic Identification and Data Capture. A sample of RFID tags and readers is shown in Figure 1 below.
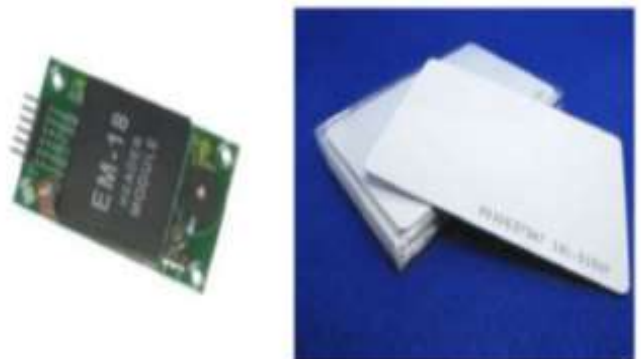

Figure 1: RFID tag and reader (Juels, 2005).

A radio frequency identification system uses tags or labels attached to the objects to be identified. Two-way radio transmitter-receivers called interrogators or readers send a signal to the tag and read its response. RFID tags can be either passive, active, or battery-assisted passive. An active tag has an onboard battery and periodically transmits its ID signal. Tags may either be read-only, having a factory-assigned serial number that is used as a key into a database, or may be read or written, RFID tag contains two parts: an integrated circuit for storing and processing information, modeling and demodulating a radio frequency signal and antenna for receiving and transmitting the signal. Tag information stored in nonvolatile memory. RFID reader transmits an encoded radio signal to interrogate the tag (Juels, 2005).

The RFID tags receive the message and respond with its identification and other information. This may be a unique tag serial number or other specific information.

2.1 How the Radio Frequency Identity Works

The Government of the Hong Kong Special Administrative Region (2008), in their report on "RFID SECURITY," explains that "Radio Frequency Identification (RFID) technology is a non-contact, automatic identification technology that uses radio signals to identify, track, sort and detect a variety of objects including people, vehicles, goods and assets without the need for direct contact (as found in magnetic stripe technology) or line of sight contact (as found in bar code technology). RFID technology can track the movements of objects through a network of radio-enabled scanning devices over a distance of several meters".

They said a "device called an RFID tag (or simply a tag) is a key component of the technology. An RFID tag usually has at least two components:

1. An integrated circuit for modulating and demodulating radio signals and performing other functions;

2. An antenna for receiving and transmitting the signal.

An RFID tag can perform a limited amount of processing and has a small amount of storage. RFID tags are sometimes considered to be enhanced "electronic barcodes". RFID tags that do not have any integrated circuit are called chipless RFID tags (also known as RF fibers). These tags use "fibers or materials that reflect a portion of the reader's signal back and the unique return signal can be used as an identifier". Systems that make use of RFID technology are typically composed of three key elements:

1. An RFID tag, or transponder, carries object-identifying data.

2. An RFID tag reader, or transceiver, reads and writes tag data.

3. A back-end database, that stores records associated with tag contents.

Each tag contains a unique identity code. An RFID reader emits a low-level radio frequency magnetic field that energizes the tag. The tag responds to the reader's query and announces its presence via radio waves, transmitting its unique identification data. This data is decoded by the reader and passed to the local application system via middleware. The middleware acts as an interface between the reader and the RFID application system. The system will then search and match the identity code with the information stored in the host database or backend system. In this way, accessibility or authorization for further processing can be granted or refused, depending on results received by the reader and processed by the database".

3. SYSTEM ANALYSIS
3.1 Analysis of the Existing System

Here, a description of VM including intelligent approach and challenges are considered. Basically, VM provides several different types of items when money is inserted into it. The VMs are more practical, easy to use, and accessible for users than the standard purchasing method. They can be found everywhere for different kinds of products such as snacks and cold drinks, coffee, tickets and diamonds, and platinum jewelers. The efficient implementation of these machines can be done in different ways by using a microcontroller and FPGA board. Figure 2 shows an abstract example of a VM.
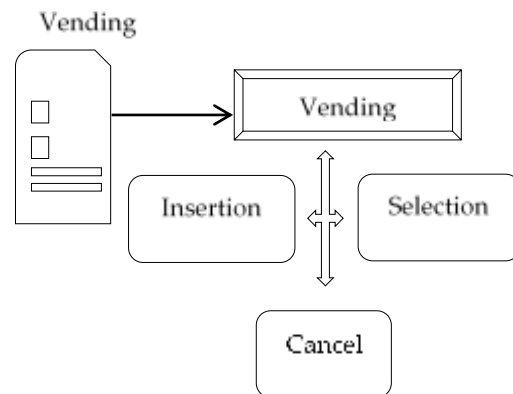

Figure 2: Basic Operations of VM.

3.2 Basic Operation of VM

1. The user inserts money, money counter sends to the control unit the amount of money inserted in the VM by the user.

2. The operation buttons are active to choose the products that people like. According to the VM's internal program, VM dispenses the products when people insert the correct amount.

3. If the program is designed to return the change, VM will return the change.

4. When a selected product is not available, VM will reject the service.

Initially, after switching on the power supply, the reset button is pressed to initiate the machine. After this, the product is selected and then the coin has to be inserted into the coin slot. Then, the coin sensor checks the validity of the coin and if it is valid, according to the training given to the box, it will accept it or else if it finds the coin invalid it will return it back. The machine will check whether the product is available or not. If the machine has a product, then the machine will go to product state and it will be delivered at the product output. If the product is not available in the machine then the control unit will demand servicing, and after service, the machine will be reset. Then the desired output or selected product will come out.

3.3 Limitations/weaknesses of the Existing System

The existing vending machine payment system suffers from the following challenges.

1. Since vending machines are usually displayed in public areas they can suffer vandalism especially due to the money tank/holder installed in the body.

2. Logistics can also be challenging, as a coin vending machine requires someone to empty the machine each day as the coin holder can fill rather quickly.

3. Some older coins are not easily readable by the mechanisms.

4. If the product is out of stock, then also the vending machine will accept the money and the client will not get their money back.

If a fake coin of the same thickness, metal, and weight is made then, the coin detector might accept it, but it won't have 100% efficiency.

4. THE PROPOSED SYSTEM

The design of vending machines has two approaches; the hardware component design and the software design.

This paper was implemented using various components that are organized in a specific way so that the device is small and portable. Each component has a specific function to perform. The project is basically divided into three parts: mechanical, electronics, and display unit. The vending machine is designed and operated by using RFID in place of using coins. The internal circuit consists of a servo motor, LCD display, keypad, servo drive motor, Arduino Mega microcontroller, Potentiometer, RFID card reader, 2way switch, Push button, buzzer, and IR sensor.

4.1 Advantages of the Proposed System

The proposed system has the following advantages.
1. The whole process is automated such that one can be able to use it when the transaction is done in the correct way according to how the machine is programmed.

2. It gives the clients a free choice to purchase products at any time of the day. One can shop for his or her intended product 24x7 hours, throughout the year.

3. Diversity in terms of the products can be handled by the vending machine.

4. Most vending machines are stationed at strategic points, which makes it convenient and time-saving because of the surety of getting what the customer wants.

5. It is card payment based and therefore the issue of lost money by the vendor is eliminated

6. It is a one-time investment on the side of the owner who doesn't need a lot of running expenses to operate. Reduction of overhead costs by not hiring staff only increases the profit margin for the owner making it a success-bound venture.

5. RESEARCH METHODOLOGY

Methodology is the study of how to perform scientific research. It is part of any analysis or research that is used to find out what type of data is maintained, what facts to find and look for, how to find them, and how to record them for usage. Many methodologies include a diagramming notation for documenting the results of the procedure; an approach for carrying out the procedure; and an objective (ideally quantified) set of criteria for determining whether the results of the procedure are of acceptable quality. There are different types of software design and research methodologies which include:
1. OOADM- Object-Oriented Analysis and Design Methodology
2. SSADM- Structured Systems Analysis and Design Methodology
3. Waterfall Methodology
4. Prototyping Methodology

In this thesis, prototyping methodology was used. A prototype is an original type, form, or instance of something serving as a typical example, basis, epitome, or standard for other things of the same category. A prototype is built to test the function and feel of the new design before starting production of a product. Prototyping is the process of quickly putting together a working model (a prototype) in other to test various aspects of design, illustrate ideas of features, and gather early user feedback. Prototyping is often treated as an integral part of the system design process, where it is believed to reduce project risk and cock. Early visibility of the prototype gives the user an idea of what the final system looks like.

The prototype used in this thesis considered the previous paying bills method for vending machines, the technology was developed to make a payment by using coins or notes. Here, we are making bill payments by rechargeable prepaid card and also making the link between the main systems to the subsystem to determine and detect the data like products available in subsystems and also whether the data like subsystem is working properly or not. In the proposed system each and every single user is provided with a RFID tag card, by using this card, each one can access or buy the available products at the centers. Before using this card, we have to recharge these cards because it is prepaid cards. To vend the products the card must be swiped on the RFID reader module, which is interfaced to the microcontroller with serial interfacing. The microcontroller reads the information from the reader or module and asks the user to select the product required, which will be shown on the LCD of the screen. Then the user is required to select the required product number through a potentiometer which acts as an input to the microcontroller. After reading the value the microcontroller will check for the required balance in the smart card, if it is sufficiently available then the product selected will be dropped on the can. If there is no cash on the card, the system will communicate with the user by displaying "insufficient balance" on the LCD.

5.1 Data Collection Methods

The researcher relied on the following for the purpose of data collection:

1. **Interview Method:** Unstructured interview is conducted with a few individuals within the sample frame to find out their opinion about the subject matter of the research. The operational method of cash-based vending machines was obtained.
2. **Libraries:** Intensive and extensive use of the libraries both public and private ones are made. Secondary data are obtained from materials such as books, periodicals, Journals, magazines, and dailies. Such data are used mainly to provide the theoretical framework for the study. Also, materials were downloaded from the internet for the purpose of this research work.

5.2 Specifications of RFID Vending Machine

Table 1: **Technical specifications of RFID vending machine**

Type	Specifications
Model	Mifare MFRC522
Type	Passive
Battery	Batteryless
Host Interfaces	SPI (serial peripheral interface)
Success/Accurate rate	Low power, high frequency
Strength from tag to reader	Very low
Frequency spectrum	HF (High frequency spectrum)/Passive
Frequency ranges in Hertz	13.56MHz (HF, Passive)
Bytes in UID (unique identification number)	4bytes
Range in meters	< 1m (3 feet)

6. SYSTEM IMPLEMENTATION

Figure 3: Development Board Implementation: 89V51RD2 Flasher Board–Interface–RS232

This board is a general purpose 40 pins 8051 development board with an onboard power supply circuit, RS232 port for serial interface with a computer and other serial devices, reset switch, power status LED and a general-purpose switch and

LED. The board is compatible with the AT89S51/52 and the P89V51RD2 microcontrollers. The P89V51RD2 allows serial programming and can be programmed directly with this board through a serial connection to a PC without the need for an additional external programmer.

(a) *Features*

i. Onboard MAX232 interface circuit for easy communication with a computer and other serial devices
ii. DC plug-in jack for power input
iii. The onboard bridge rectifier enables the board to accept both AC and DC input voltages
iv. Onboard 5V regulator(LM7805) with filtering capacitors and heatsink
v. Power Status LED(Green) and a general

(b) *Purpose User LED(Red)*

i. Onboard quartz crystal 11.0592 MHz oscillator circuit
ii. Port extensions for all ports
iii. External pull-up resistors for Port 0
iv. Vin, 5V and Gnd bus provided

Figure 4: Product Input Box

The machine is designed to have provisions for the following:

1. Product Selection Box
2. Account Recharge
3. Check Balance
4. Card Swipe
5. Delete button
6. Reg button

Each of the buttons executes a particular function assigned to it as shown in Figure 5.

The vending machine is loaded with drinks for customers to buy. For the design of the vending machine operations, it is required that the customer will have a card for making payment for the purchases.

Figure 5: The vending machine loading slot

It is specified that the customer should swipe the card on the machine to validate the payment card and check if it has enough balance to proceed with the purchase as shown in figure 8.

Figure 6: Machine requesting for Card to be swiped

After swiping the card, the machine displays the customers balance as shown in Figure 9
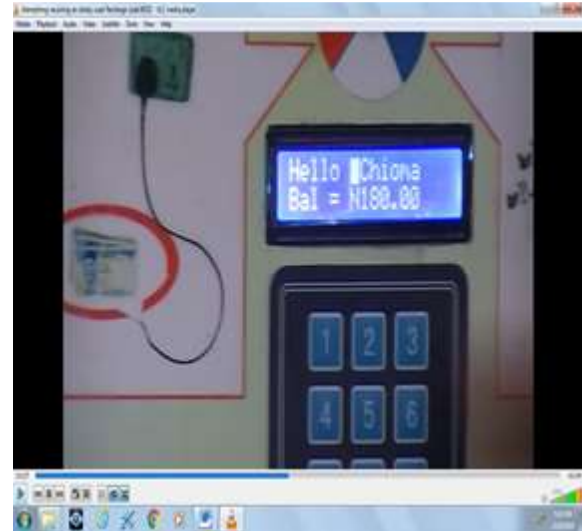
Figure 7: Vending machine showing the customer's account balance

The machine will request that the user should select the product that he/she wants if the card is well-funded as shown in Figure 10.

Figure 8: Specification for Product Selection

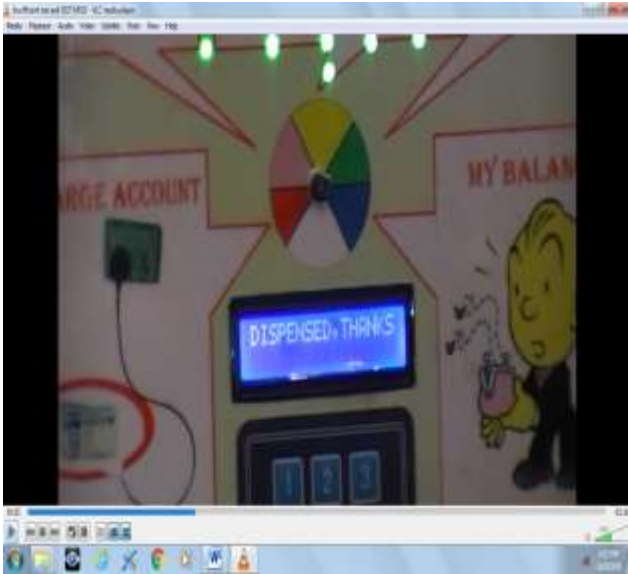Once the product is selected, it drops the product from the machine

Figure 9: Message displayed once product is dispensed

Figure 11: Specification for Card Recharge

Once the code is entered, the machine displays a message showing that the recharge was successful as shown in Figure 14. Payment for the recharge is paid to and gotten from a registered vendor

Figure 10: The vending machine displaying the balance after the transaction

To recharge the card, the customer is expected to enter the recharge code as shown in Figure 13.
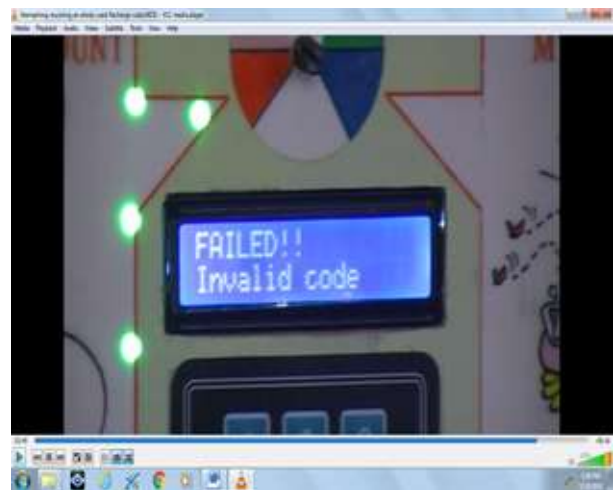

Figure 12: The Display after card Recharge

Figure 13: Message displayed if the card recharge failed

Figure 14: Message displayed if the card has insufficient balance

6.1 Hardware and Operating System Requirements

In the system developed, the following are required.

6.1.1 Hardware / Components Requirement

The materials used in the construction of the product are Stainless Steel Sheet Metal and Cast Iron. For the container that holds the dispenser and electronic circuit, wood is cut and joined at the edges. The RFID reader is bolted to the front side of the container. At its back, is the power connection, and on top is a door hinged for accessing the dispenser.

The requirements for the implementation of the vending machine are:

    i.   Single CH Relay Module
    ii.   2CH Relay Module
    iii.   4CH Relay Module
    iv.   8CH Relay Module
    v.   IR Distance Sensor
    vi.   9g Servo
    vii.   48g Servo
    viii.   Bluetooth module
    ix.   Arduino UNO R3
    x.   LCD 602
    xi.   LCD 2004
    xii.   Keypad 4x3
    xiii.   Buzzer
    xiv.   Resistors, LED, Diode
    xv.   RFID card reader
    xvi.   RFID card
    xvii.   Colour Sensor
    xviii.   Stepper motor

6.1.2 Software Requirements

The software part of programming was through Arduino Mega software (IDE). It is easy to write code and upload it to the board. C and C++ languages are used for programming.

6.2 Detailed Implementation Plans

The vending machine was implemented in phases.
Step one: Design the circuit diagram

6.2.1 System Testing

This section is chiefly the implementation of the application and testing for issues and non-functional properties such as speed and robustness. The test is simply the execution of the implemented application with sample data to ensure that all specified objectives have been met appropriately in order to ensure a high-quality, user-friendly application. In this section, we will show a tabulation of the summary of the result that we got when the machine (model) was tested. Each control button on the machine's control software was tested and its effect on the model was observed. Table 5 below shows the test and the test result when no fault is encountered.

6.2.2 Performance Evaluation

This thesis has presented our knowledge about the machinery and technology involved in the most common vending machines present all over the world. It helps increase efficiency by lowering dependence on manpower. The desired outcome is achieved as per the user's requirements in the form of a product dispensed by the machine. How easier it would make people obtain products from vending machines rather than waiting in queues for long hours. We also learned about the functioning of various instruments. This includes the functioning of RFID, Microcontroller AT89C51, Motor drivers, etc. All these have contributed greatly to improving our knowledge about the functioning and performance of a vending machine. The system was able to validate payment card data before dispensing can take place. Hence the performance of the system can be rated at 95%.

6.2.3 Training

For the new system to function effectively and efficiently, educating and training vending machine operators is necessary. Training is conducted for the person selected to do the job of registering new cards, printing the recharge codes/cards, and placing products on the vending machine. The selected person is trained for a period of time on how to manipulate and operate the system so as to be acquainted with the vending machine and the system design. The operator is also given procedural manuals to assist them in operating the system.

7. CONCLUSION

An automated Vending Machine for the sale of drinks has been designed and implemented in this thesis. An RFID payment system was also incorporated to make the Vending Machine cashless in operation. When this RFID-based Vending Machine is compared with the cash-based alternative, it is noted that the RFID-based has outperformed the cash-based one in terms of efficiency, security, and sales tracking and it is therefore a better machine used for the sale of drinks.

This thesis has presented to our knowledge the techniques used to develop an RFID technology-based Vending Machine for the sales of drinks. The realized product has the advantage of data flexibility and efficiency and has a better way to manage the financial returns of the business. The prepaid card must be funded before it can be used for transactions on the Vending Machine.

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Enhancing Security Measures for Mobile Banking Applications: A Comprehensive Analysis of Threats, Vulnerabilities, and Countermeasures in Kenya Banking Industry

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Abstract:

This study focused on the risks and vulnerabilities associated with mobile banking apps in the Kenyan banking sector. While these apps offer convenience and accessibility, they are also exposed to various threats that can compromise user information and financial transactions. The study aimed to identify these risks, vulnerabilities, and attack routes specific to Kenyan mobile banking apps and provide remedies to enhance their security. The research had three main goals. Firstly, it seek to examine and evaluate the primary vulnerabilities and attack vectors affecting Kenyan mobile banking apps and understand their impact on user data and financial transactions. Secondly, it aimed to assess the common flaws in these apps, considering both technological issues and user behavior patterns. Lastly, it aimed to propose appropriate security measures customized for the Kenyan banking sector, considering user behavior and technological advancements. This included exploring encryption, multi-factor authentication, and user awareness programs to promote secure banking habits. The research intended to assist financial institutions and customers in enhancing the security of their mobile banking experiences by conducting a thorough assessment of risks and vulnerabilities in Kenyan mobile banking apps and offering practical advice. It emphasized the importance of understanding and addressing the specific challenges faced by the Kenyan banking sector to ensure secure and reliable financial transactions through mobile platforms.

Keywords: Mobile banking apps, Cybersecurity, Threat actors, Malware, Phishing, Social engineering, man-in-the-middle attacks, Vulnerabilities, Countermeasures, User behavior patterns.

1. Introduction

Mobile banking apps have simplified and streamlined financial transactions. These apps let users check account balances, transfer money, pay bills, and apply for loans on their smartphones, transforming bank interactions. Smartphones and mobile internet access have made mobile banking services essential to the financial landscape (Shaikh et al., 2022). Mobile banking apps provide many advantages but pose hazards and obstacles. The quick speed of technological improvements has opened new opportunities for innovation and enhanced user experiences, but it has also uncovered weaknesses that malevolent actors may exploit. Financial organizations and customers now worry about mobile banking app security. Advanced hacks threaten user data and financial transactions on mobile banking apps. Data from mobile banking apps is stolen through malware, phishing, social engineering, and man-in-the-middle attacks (Cinar & Kara, 2023).

Such breaches can result from financial losses, identity theft, and bank-client distrust. Given the importance of mobile banking apps and the rising frequency and complexity of cyber-attacks, a complete examination of the Kenyan banking industry's risks, vulnerabilities, and responses is urgently needed.

Kenyans are increasingly using mobile banking apps for their financial demands (Misati et al., 2022). Thus, financial institutions and clients must comprehend the Kenyan banking industry's particular issues and find appropriate security measures. This study examines Kenyan mobile banking applications' dangers and attack vectors and how they exploit vulnerabilities to compromise user data and financial transactions. It also identified mobile banking apps' most prevalent vulnerabilities, including software defects, architectural weaknesses, and user behavior and awareness. Effective countermeasures and security measures may be created and executed by identifying the difficulties in limiting risks and improving Kenyan mobile banking application security.

A comprehensive analysis of threats, vulnerabilities, and countermeasures in mobile banking applications is essential to ensure the security, privacy, and integrity of financial transactions worldwide. By understanding the evolving threat landscape and implementing effective security measures, the banking industry can protect sensitive user information and maintain customer trust.

Recent research conducted in the field of mobile banking security has addressed several key aspects. For instance, a study by Suh, Lee, and Lee (2020) examined the effectiveness of various authentication methods in mobile banking applications, highlighting the importance of user-friendly yet secure authentication mechanisms.

In terms of vulnerabilities, researchers have explored areas such as secure coding practices, encryption techniques, and threat intelligence sharing. A study by Chang, Leu, and Chen (2021) investigated the impact of secure coding practices on mobile banking application security, emphasizing the significance of adopting secure coding guidelines and conducting regular code reviews. To combat emerging threats, financial institutions and app developers have implemented various countermeasures. For instance, the use of advanced analytics and machine learning algorithms has shown promise in detecting and preventing fraudulent activities in mobile banking (Huang et al., 2021).

Looking ahead, it is crucial to stay abreast of the latest developments in mobile banking security. Ongoing research and industry collaborations aim to identify emerging threats, vulnerabilities, and best practices. Keeping up with current research findings and incorporating them into security strategies will be vital for maintaining a strong security posture in the ever-evolving landscape of mobile banking applications.

1.1 Problem Statement

The Kenyan banking industry has witnessed a significant shift towards mobile banking applications, enabling customers to conduct financial transactions anytime and anywhere. However, this digital transformation brings inherent risks, as cybercriminals are continually evolving their tactics to exploit vulnerabilities in mobile banking applications. The increasing sophistication of threats and the potential compromise of user data and financial transactions pose a considerable challenge to the security of these applications (Cinar & Kara, 2023). Therefore, it is crucial to identify the primary threats, vulnerabilities, and attack vectors specific to the Kenyan banking industry to devise effective countermeasures and enhance the security of mobile banking applications.

1.2 Study Objectives

i. To identify and assess Kenyan mobile banking applications' main dangers and attack vectors.
ii. To assess the most common vulnerabilities in mobile banking applications used in Kenya, considering both technical and human factors.
iii. To offer appropriate security and countermeasures for Kenya's mobile banking apps.

2. Literature Review.

2.1 Mobile Banking

The fashion of using movable electronic devices, such as smartphones and tablets, to execute fiscal deals and access banking services is known as mobile banking. Checking account balances, transferring money, paying bills, and indeed remote check depositing are common aspects of mobile banking. Mobile banking's security is a major problem, despite the convenience it offers. None of the evaluated mobile banking applications offered an appropriate degree of safety, according to a study by Positive Technologies (Saprikis et al., 2022). The study looked at 14 fully functional mobile banking apps for Android and iOS, with the requirement that they be accessible through official app stores and have at least 500,000 downloads (Li et al., 2022). Based on the effects of a hypothetical attack on user data and the program itself, the vulnerability risk was evaluated.

According to the survey, 13 out of 14 mobile banking applications on the client side—that is, the application that is downloaded and installed on a user's device—allow attackers to access customer data. Without administrator rights, more than a third of vulnerabilities may be exploited. Compared to Android clients, iOS client applications often have fewer security flaws. However, 100% of mobile banking clients have flaws in their code, such as a lack of obfuscation and a lack of safeguards against code injection and repackaging (Muhammad et al., 2023).

Insecure deep link handling and the existence of sensitive data in the client-side file system of roughly half of the programs are two additional serious vulnerabilities that have been found. Banks may experience financial losses as a result of these vulnerabilities, and sensitive user data like card numbers and account balances may also be stolen.

Furthermore, problems such as a lack of certificate pinning to authenticate SSL certificates were discovered to make 13 out of 14 applications vulnerable to man-in-the-middle attacks. The majority of the vulnerabilities were on the server side, which is a web application that communicates with the mobile client via the internet and had 54% of all vulnerabilities (Shahid et al., 2022). Half of mobile banks were vulnerable to fraud and money theft, with each having an average of 23 server-side vulnerabilities. One third of banks had card information in danger, and five out of seven allowed hackers to acquire user passwords. Furthermore, none of the server sides had a security level higher than "medium," and more than half of mobile banks had high-risk server-side vulnerabilities.

2.1.1 Mobile Banking in Kenya

By allowing unprecedented levels of financial inclusion, mobile banking has transformed Kenya's financial environment. Kenya's financial system currently heavily relies on Safaricom's mobile money network, M-Pesa. Users of M-Pesa may easily deposit, withdraw, transfer, and pay for goods and services using a mobile device; these capabilities have significantly aided Kenyans in being financially included 8k account, and a sizable fraction of these people utilize mobile banking services like M-Pesa (Mulili, 2022).

The significance of M-Pesa goes beyond merely offering fundamental financial services. Additionally, it has aided in the growth of online lending platforms that provide microloans to previously unbanked or underbanked Kenyans (Mulili, 2022).

These platforms allow Kenyans to obtain loans and other financial services through a new channel by using mobile data to assess creditworthiness. The widespread usage of M-Pesa has sparked a variety of innovations in other fields, such as health, agriculture, and energy, changing Kenya's socioeconomic environment. However, a further in-depth study is required on the specific effects of M-Pesa on these industries and the Kenyan economy as a whole.

Kenyan mobile banking applications, like those used globally, are vulnerable to many kinds of cyber-attacks in terms of security (Njenga & Muganda, 2021). Common vulnerabilities include unsecured direct object references, insecure communication, and inadequate data protection. When a user's input determines whether a program should have direct access to an object, this is known as an insecure direct object reference. Attackers can thereby circumvent authentication and gain direct access to data. On the other side, insecure communication occurs when data is transferred via a network without sufficient encryption, leaving it open to interception. Unauthorized access to data that is at rest, in use, or in transit is protected by insufficient data protection. Developers must use secure communication protocols, make sure certificates are validated correctly, and use secure application design to reduce these risks (Cinar & Kara, 2023). Despite these difficulties, mobile banking has the potential to be beneficial, especially in enhancing financial inclusion, making it a crucial area for ongoing growth and investment.
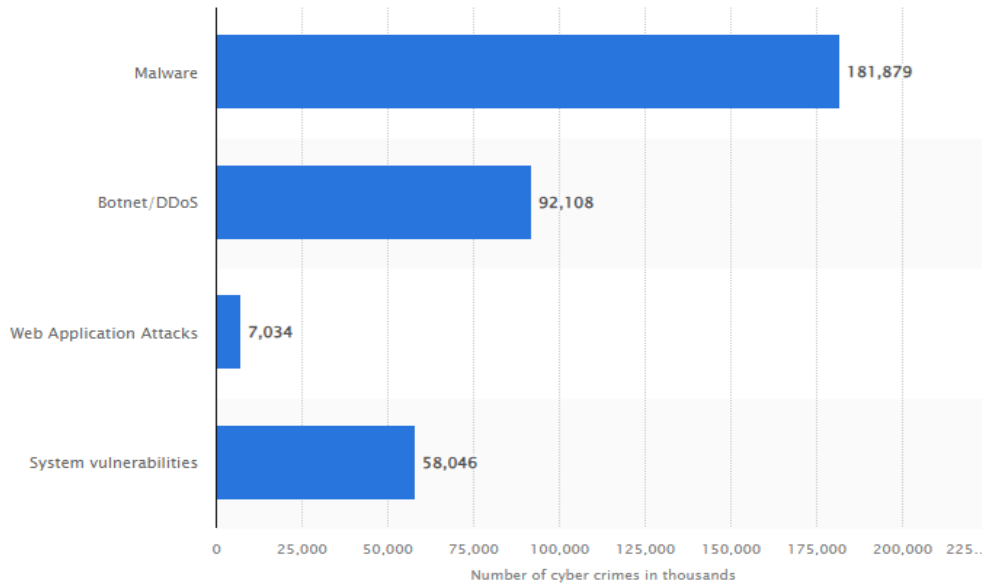
Figure 1: Number of online crimes reported in Kenya. Source, (Baron, 2021)

2.2 Cybersecurity Threats and Vulnerabilities in Mobile Banking.

Mobile banking applications are vulnerable to a range of cybersecurity risks and flaws that might be used by bad actors. In 2020 research by Positive Technologies, which looked at 14 fully functional mobile banking applications, it was shown that none provided an adequate degree of security (Positive Technologies, 2023).

The analysis discovered that these programs have flaws on both the client and server sides. Attackers were able to access customer data in 13 out of the 14 tested applications on the client side, which is the term for the mobile banking app that is installed on a user's device (Positive Technologies, 2023). In 76% of situations, these flaws could be exploited without requiring physical access to the device, and more than a third of them could be used without administrator (jailbreak or root) rights (Akpan et al., 2022).

In terms of individual flaws, improper deep link handling was one of the most hazardous ones found in Android applications. Attackers can use these deep connections to carry out harmful actions, including loading a webpage with malicious code and interacting with the JavaScript APIs of the application (Arogundade et al., 2023). Inadequate code protection was another flaw that might allow attackers to decompile the application's code and obtain sensitive information, including encryption keys and passwords. Each mobile bank had an average of 28% of cyber threats and Ransom malware vulnerabilities composed 50.2% (Bernik, 2022). The server side is a web application that communicates with the mobile client via the internet. Potential fraud, financial theft, and user credential theft were some of the threats linked to these vulnerabilities.

Pearson's chi-square test results (***—$p < 0.001$, **—$p < 0.005$, *—$p < 0.05$).

Victimization	Location	Never	Once	Twice or More	Not Specified	x^2
cyber harassment	rural	71.0	9.1	15.7	4.3	1.48
	urban	68.4	10.8	16.9	3.9	
extortion in cyberspace	rural	86.7	5.0	4.8	3.5	2.87
	urban	89.3	3.2	4.2	3.2	
malware infection	rural	61.9	17.0	17.9	3.1	3.79
	urban	58.0	21.3	17.6	3.1	
impersonation/phishing	rural	79.5	8.9	8.7	3.0	3.95
	urban	75.4	12.1	9.7	2.8	
dissemination of indecent material	rural	81.1	8.5	7.6	2.8	13.49 **
	urban	75.1	7.7	14.2	2.9	
spreading hate speech	rural	76.2	10.7	10.2	3.0	14.66 **
	urban	71.2	8.3	17.6	2.9	
spreading rumors	rural	76.2	10.4	10.7	2.8	17.23 ***
	urban	68.8	9.0	19.2	2.9	
online banking frauds	rural	91.1	2.2	2.4	4.3	2.12
	urban	90.0	3.7	2.4	3.9	
ransomware	rural	90.4	3.5	2.8	3.3	2.24
	urban	91.0	3.4	1.5	4.1	
wireless network interference	rural	81.5	7.9	6.8	3.7	7.65 *
	urban	75.6	10.5	10.3	3.7	

Figure 2: Cybercrime victimization categories. Source (Bernik et al., 2022).

2.3 Cybersecurity in Kenya.

Kenya has given substantial attention to cybersecurity. In August 2022, the Kenyan government released its National Cybersecurity Strategy, which serves as a guide for dealing with emerging cyberthreats (Kondlo et al., 2022). To coordinate multi-agency activities for cybercrime detection, prohibition, prevention, response, investigation, and prosecution, the strategy, which is in accordance with the Computer Misuse and Cybercrimes Act of 2018 (CMCA 2018), was developed (Khan et al., 2022). The development of strong governance structures, strong policy, legal, and regulatory frameworks, protection of crucial information infrastructure, development of more advanced capabilities and a skilled cybersecurity workforce, reduction of crimes and incidents, and promotion of cooperation and collaboration are the six main pillars that support the strategy.

The National Cybersecurity Strategy (NCS) 2020–2023 was developed by the Kenyan government to increase the country's cybersecurity readiness. Plans are presented for establishing a National Cyber Command Center, improving the legal and regulatory landscape, encouraging research and innovation, and strengthening expertise and competence in cybersecurity-related matters (Pavel, 2023). Cyberthreats are the most common type of vulnerabilities encountered by majority of the victims in Kenya. Cybercriminals are increasingly focusing their attacks on small organizations such as banks at prevalence rate of 43%, taking advantage of a lack of security knowledge and fundamental protection measures (Pawar et al., 2022).

According to the research, phishing, banking Trojans, and fraud involving ATMs are the most typical sorts of assaults, and the financial sector is the one that is most frequently targeted in Kenya (Maluleke, 2023). Due to their extensive use across the nation, mobile money services are also being targeted more frequently. The research does, however, point out various issues with Kenya's Cybersecurity environment. These include a large shortage of Cybersecurity experts, limited financing for initiatives, and lax enforcement of rules and laws relating to the field. Kenya's Cybersecurity capacity maturity is evaluated in 2021 research by the Global Cyber Security Capacity Centre (GCSCC) at the University of Oxford (GCSCC, 2021). The report rates a nation's level of Cybersecurity maturity using a five-stage model (from start-up to dynamic). Kenya received a "formative" grade across the board, meaning that while efforts are being made in these areas, they are not systematic, extensive, or part of a larger national plan. According to user behavior and awareness, the Serina research contends that internet users in Kenya have a low degree of Cybersecurity knowledge (David et al., 2022). According to the research, more needs to be done to inform people and companies about cyber threats and how to be safe online.

Through numerous efforts, the MPESA app in Kenya has proved its dedication to safety, making it a trustworthy and secure mobile money transfer platform. To begin, the app employs strong encryption techniques to safeguard user information and financial transactions, ensuring that personal information stays protected and secure.

MPESA has also adopted multi-factor authentication, which requires users to provide additional verification procedures in order to access their accounts, preventing unwanted access (Mugo, 2023). The software also provides real-time transaction notifications, allowing users to spot and report any suspicious activity as soon as it occurs. Furthermore, MPESA works with regulatory organizations and financial institutions to adhere to high compliance standards and anti-money laundering legislation, which improves the platform's security.

Given the wide use of mobile banking services in Kenya, this study's conclusion that there's a considerable threat involved with using mobile banking operations is material. The results should be taken cautiously in the Kenyan context because the study did not explicitly examine Kenyan banking applications.

2.4 Security Measures and Countermeasures in Mobile Banking.

Over time, mobile banking has expanded significantly, and with that expansion have come more potential dangers and weaknesses. Encryption, multi-factor authentication, secure software development methods, and stoner mindfulness programs are just a few of the remedies that have been created and put into place to lessen these troubles (Mugo, 2023). Information or data is converted into a law through the process of encryption to help prevent unauthorized access. In the environment of mobile banking, encryption may be used to guard both data at rest (stored data) and data in conveyance (data being transferred).

For example, mobile banking operations generally employ the cryptographic protocols Safe Sockets Layer (SSL) and Transport Layer Security (TLS) to enable safe communication across a computer network (Muhammadovich, 2023).

These protocols cipher the data being transmitted between the stoner's mobile device and the bank's servers to make it harder for bushwhackers to block and crack the data.
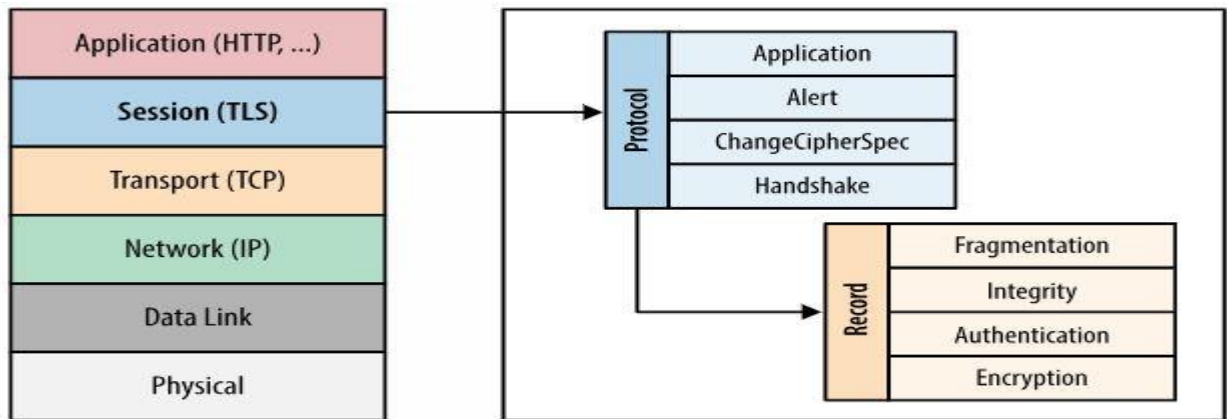
2.5 Cybersecurity in Kenya.

Figure 3: Transport Layer Security (TLS). Source. (Grigorik, 2023)

Multi-Factor Authentication (MFA) MFA is an authentication type that requires the stoner to provide two or more verification factors before giving access to a resource, similar to an online account or an These rudiments constantly include what the person performs (similar to a biometric point), what they retain (similar to a mobile device or a palpable commemorative), and what they know (similar to a word) (Suleski et al., 2023). By requiring several pieces of identity, MFA adds an extra layer of security, making it harder for unauthorized users to get access even if one element, like a password, is stolen (Taherdoost, n.d.). Implementing safe software development techniques is essential for avoiding vulnerabilities in mobile banking applications (Cinar & Kara, 2023).

In order to do this, security concerns must be included at each stage of the software development lifecycle. For instance, to find and address any security problems, developers should regularly do security testing, code reviews, and vulnerability assessments. Also, they should follow the concept of least privilege, ensuring that programs and processes have just the access they require.

Despite the finest technical defenses, the human factor still plays a big role in the security of mobile banking. Initiatives to increase user knowledge and education are therefore crucial. Users should be educated about the dangers of mobile banking and trained to recognize and stay clear of possible hazards like phishing scams (Mamolo, 2022).

They should be urged to adopt safe practices, including routine software updates, strong passwords, and only downloading programs from reputable websites.

These precautions would be very useful for the Kenyan banking sector, which, like many others, is struggling with the security issues posed by the quick uptake of mobile banking (Suleski et al., 2023). The nation's banks ought to research these best practices and put them into effect, always keeping in mind the particular context of their operations and clients. The security of mobile banking in the nation might also be improved by partnering with other players in the cybersecurity ecosystem and regulatory bodies.

2.6 Gap in Literature.

The analysis of the literature indicates a variety of security techniques and defenses used in mobile banking throughout the world. End-to-end encryption is recognized as a key element of safe mobile banking (Len et al., 2023). It guarantees that sensitive information sent across the network, including login passwords, account details, and transaction data, cannot be intercepted or read by unauthorized parties. The importance of multi-factor authentication as one of the security measures included in digital banking has also been acknowledged (Suleski et al., 2023). This technique combines something you have (a device or object) with something you are (a biometric) or something you know (a secret), creating a strong security layer that is less likely to be compromised by attackers and hackers.

These technologies have a lot of promise, but they also have a lot of drawbacks. For instance, users may overlook security precautions due to multi-factor authentication's hassle, leaving the system more open to infiltration (Pöhn et al., 2023). These methods have some potential, but there are several issues. Due to the inconvenience of establishing multi-factor authentication, for instance, customers may decide to take shortcuts, thereby increasing the vulnerability of the system.

The analysis also identifies blockchain technology as a potential future approach that might be utilized to develop a large-scale transaction system for banking that is more safe, practical, and effective. The research demonstrates a sizable gap in the context of the Kenyan banking industry, notwithstanding these developments. While worldwide trends are a good place to start, there is a distinct absence of in-depth studies focusing on the dangers, weaknesses, and defenses related to mobile banking apps inside the Kenyan banking sector.

It is crucial to perform localized research because of Kenya's distinctive socioeconomic and technical environment. The goal of this research is to not only identify the precise dangers and weaknesses that Kenya's banking sector is subject to but also to develop security measures and responses that are specifically tailored to the regional environment. By doing so, the sector may increase the impact of these initiatives while avoiding any possible drawbacks for the user experience.

3. Research Methodology.

This study uses a mixed-methods methodology, integrating qualitative and quantitative techniques, to provide a thorough knowledge of the possible security concerns in Kenyan mobile banking apps. Stages for data gathering and analysis are included in the process.

3.1 Data Collection.

3.1.1 Secondary Data Collection.

Secondary data is collected via a review of existing literature. The aim is to develop an understanding of the broader context as well as identify key trends and patterns in the field of mobile banking application security. This review includes scholarly articles, cybersecurity reports, regulatory documents, and relevant case studies. Secondary data will be extremely important to this study since it will give a thorough and complete knowledge of the security of mobile banking applications. This research will gain important insights into the larger context and major developments in the sector by a thorough assessment of the available literature, which includes scientific publications, cybersecurity reports, regulatory documents, and pertinent case studies. The researchers will be able to draw on the knowledge and discoveries of other researchers through the study of secondary data, enabling a more in-depth investigation of the research issue. This study will be able to enrich its analysis, strengthen its arguments, and produce solid and insightful conclusions by combining secondary data with the primary research findings, such as semi-structured interviews with cybersecurity experts, users of mobile banking apps, and law enforcement personnel.

4. Data Analysis.

The data analysis strategy will be modified as this study only uses secondary data sources. Thematic analysis will be used heavily in the study to evaluate the qualitative data gleaned from the studied literature. We will identify and analyze the main themes, trends, and patterns associated with the risks and shortcomings of Kenyan mobile banking applications. The replies of participants from the literature might be examined to get fresh perspectives and comprehensions.

In addition to theme analysis, statistical methods will be used to examine any quantitative information from the secondary sources that is accessible. This research attempts to characterize and investigate the general patterns and trends in the data, including the prevalence of certain vulnerabilities in mobile banking applications as well as the frequency and diversity of cyberthreats. The study can offer a quantitative viewpoint that supports the qualitative findings by using statistical analysis.

5. Way Forward for the Banking Sector in Kenya.

Like in many developing nations, Kenya's banking industry is going through a dramatic shift that is mostly driven by digital technology. Particularly with regard to mobile banking, this development has increased the potential for financial inclusion but also raised several security issues (World Bank, 2017). In view of these events, the following proposals are made regarding Kenya's banking system's future:

As the financial industry becomes more digital, security must be a top priority. Institutions must invest in innovative safety measures to safeguard their systems and customer data from cyberattacks. This necessitates the use of security solutions like end-to-end encryption and multi-factor authentication, as well as regular security audits to detect and fix any possible problems.

Enhance human awareness and education: It's important to inform clients about safe online banking habits because many security breaches are caused by human mistakes. Banks should create user awareness campaigns that educate people about issues including phishing scams, secure password usage, and the value of protecting personal devices.

Promote financial inclusion by reaching marginalized people who might not have access to regular banking services through mobile banking. To make their mobile banking systems more accessible and user-friendly, especially for consumers in rural regions or those who might not be tech-savvy, banks should continue to develop and improve them.

Create Regulatory Frameworks: The regulatory frameworks that control the banking industry should grow along with it. Regulators must keep up with the most recent advancements in digital banking and adjust their policies and procedures accordingly. This covers laws governing digital financial services, client data privacy, and cybersecurity.

Examine Emerging Technologies: The banking sector has to be open to investigating emerging technologies that might boost the safety and efficiency of their products. For instance, blockchain technology has the power to totally alter how payments are conducted and recorded, increasing security and openness.

Localize study and solutions: As was already said, little study has been done explicitly in the Kenyan setting. To fully comprehend the distinct difficulties and possibilities confronting the Kenyan banking sector going forward, further regionalized study will be required. The creation of specialized solutions that address the unique requirements and environment of the Kenyan market may then be guided by the study.

6. Conclusion.

Mobile banking security measures have significantly advanced over time as slice-edge technology is employed to ensure the secure processing of sensitive data. One of the crucial rudiments of safe mobile banking is end-to-end encryption, which encrypts all connections between a mobile device and a banking server.

This fashion prevents unauthorized parties from interdicting or reading sensitive data being transmitted over the network, such as login watchwords, regard information, and sale data. Multi-factor authentication has been stressed as a pivotal security element in the environment of digital banking, coupled with encryption.

To log into a digital bank account, this approach combines a number of factors, similar to the stoner's knowledge (for example, a secret), their identity (for example, a biometric), or their power. Multi-factor authentication greatly lowers the chance of successful intrusions by offering robust authentication.

However, just as the technical environment is still developing, cybercriminals' risks are also growing. To keep up with these dangers, banks must constantly develop and modify their security measures. One innovative method that could offer transactions that are more effective, convenient, and secure is the combination of blockchain technology and multiple-factor authentication. Future research and development in this area have a ton of room.

Although security mechanisms have improved, it's important to keep in mind that no system is impervious entirely. Users must thus be aware of and follow suggested security procedures, including routine password changes, staying away from unsafe Wi-Fi networks, and not installing dubious applications. The entire security of mobile banking depends on the joint efforts of the banks in putting in place strong security measures and the users in abiding by safe practices.

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The Usage of Open-Source Applications in Teaching and Learning of Computing Courses in the Institutions of Higher Learning

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Abstract: Open Source Application is a concept of software development rather than a specific type of application. Information sharing is encouraged through open source software, which is seen as a strong and advantageous idea. The purpose of the study was to determine the impact of open source applications usage in teaching and learning of Computing Courses in the Institution of Higher Learning as well investigating the kinds of open source software's and accessibility that potential computing educators in the area under study are familiar with. The importance of this study, which examined Zetech University prospective computing teachers' use of open-source software in higher education, will give the university's administration and various departments inside knowledge of how familiar and knowledgeable these individuals are with open source software. By doing this, the authority will be able to identify their weaknesses and opportunities for improvement, such as Universities should replace proprietary software with open-source software to reap future benefits like license renewal and file upgrades. In the investigation, a mixed method approach was used. 180 staff members and students were purposefully chosen at random for the study at Zetech University, and a sample of 118 was taken. In the quantitative approach, the descriptive statistics were employed to display the distribution of scores using a few indices. Based on the findings 90.7% were familiar with open source software's while 9.3% were not familiar. 98.3% suggested that it was essential to use open source applications in teaching computing courses while 1.7% rejected the narrative. 71.2 % of the respondents were familiar with universities using open source software's in their Curriculum*s* while 28% were not familiar with any. 46.6% of the respondents ascertained that the university has provided an environment to access open source applications,31.4% disagreed, while 14.4% were neutral. Universities should switch to open source software instead of proprietary software to save money on license renewal and upgrade fees, a position that was strongly supported by 38.1%, agreed by 40.7%, was neutral by 12.7%, and disagreed by 5.1% and 3.4%. The paradigm for education must change to Education 4.0 in order to give innovatively productive education. Faculty members and educators can employ a range of cutting-edge tools and technology to do this. These technologies can be used to track students' participation and engagement in the program both on and off campus with the help of IoT and ontology. Virtual learning environments can also be utilized in conjunction with different blended learning environments to accommodate a range of learner types. Practitioners must be aware of the potential negative effects of using open source software while developing a product in order to be ready for them, anticipate them, and take the required steps to overcome them. The institutions ought to be linked to websites which features a list of open source programs associated with many categories, including security, cloud computing, small enterprises, big data, games, etc. Aspiring computer science teachers' knowledge of open source programs will be improved as a result. This will enhance the open source software understanding of aspiring computer science teachers.

Keywords: *Open Source, E-learning Platforms, Courses, Computing, Education*

1.0 INTRODUCTION

Open-Source A type of application is one in which the original source code is made publicly accessible for people to view, edit, utilize, and develop computer programs. Linux is one of the most well-known instances of an open source application and is frequently used as a substitute for expensive operating system (OS) programs. A license to use, alter, and redistribute the code is included in an open source application. Open source applications can be used to create goods that are sold commercially. Open Source Application is a concept of software development rather than a specific type of application. Information sharing is encouraged through open source software, which is seen as a strong and advantageous

idea. An unbiased evaluation of popular open source software (OSS) products, most of which are created by unpaid volunteers, frequently reveals that they are of a higher caliber than the software produced by some of the most well-known companies, which unquestionably employ highly intelligent individuals. Every member of the community contributes to the so-called "collective open source knowledge" by coming up with fresh concepts, creating innovative features, offering test data, and recording deployments. The importance of this study, which examined Zetech University prospective computing teachers' use of open-source software in higher education, will give the university's administration and various departments inside knowledge of how familiar and

knowledgeable these individuals are with open source software. By doing this, the authority will be able to identify their weaknesses and opportunities for improvement, such as Universities should replace proprietary software with open-source software to reap future benefits like license renewal and file upgrades. Seminars about the use and advantages of open-source software should be held. This study will assist aspiring computing teachers in realizing that open source software is more affordable than proprietary software, is of higher quality (i.e., has fewer errors and more features), and is easier to access, use, and distinguish from pirated software, proprietary software, and open source software. Finally, it adds to the body of knowledge in computing and acted as a springboard for other, unfinished study.

The study was guided by the following objectives:

a) To determine the impact of open source applications usage in teaching and learning of Computing Courses in the Institution of Higher Learning

b) To investigate the kinds of open source software's and accessibility that potential computing educators in the area under study are familiar with.

Research Questions

a) What is the impact of open source applications in teaching and learning of Computing Courses in the Institution of Higher Learning?

b) What are the kinds of open source software's and accessibility that potential computing educators in the area under study are familiar with?

2.0 LITERATURE REVIEW
2.1 Types of open source applications for teaching & learning of computer courses.

The most commonly used open source application is Moodle. Online learning management systems built on the Moodle platform have long supported classroom instruction. Martin Dougiamas, a WebCT administrator at Curtin University of Technology, began work on Moodle in 1999, according to its history (Kats, 2010). This platform is fully functional, adaptable, and extensively used by colleges worldwide. According to Cole & Foster (2007), Moodle is utilized by more than 30,000 educational institutions worldwide, including those in Hong Kong and other Asian nations (Luk et al., 2018). Technology and student learning needs can be

combined through e-learning, according to De Clunie et al. (2013). Additionally, it was stated that planning in the learning management system must consider performance expectations, effort expectations, social effects, and facilities (Ramllah & Nurkhin, 2020). These expectations are established in an organized plan that controls the order, techniques, and resources for learning. As a result, they will be prepared to follow the lesson in every class. Based on this idea, Moodle-based learning planning can be evaluated using the following criteria: 1) posting the semester learning plan online; 2) explaining the semester learning plan; 3) creating a learning contract between the lecturer and students; and 4) posting the learning contract online.

2.2 usage of open source applications in learning

The usage of software programs like OPEN Source Impress, Writer, and Calc, which are not only free but also simple to get on the Internet for free and without charge, is one of the benefits of technology when it comes to training our instructors. Like using Impress to create a straightforward presentation, using Open Source Software in Education Technology is fantastic.

Information sharing is encouraged through open source software, which is seen as a strong and advantageous idea. An unbiased evaluation of popular open source software (OSS) products, most of which are created by unpaid volunteers, frequently reveals that they are of a higher caliber than the software produced by some of the most well-known companies, which unquestionably employ highly intelligent individuals. Every member of the community contributes to the so-called "collective open source knowledge" by coming up with fresh concepts, creating innovative features, offering test data, and recording deployments. (Joshua,2012).

As a result, community members' ongoing OSS advancements produce tools that are more dependable and adaptable and have greater quality than their commercial counterparts. As a result, several well-known open source software applications go through continuous development and have a higher reliability rate than their commercial counterparts (Lakhan and K. Jhunjhunwala,2008). Therefore, keeping track of such modifications is a fantastic learning tool that allows a student to regularly analyze and study the changing code in order to comprehend its logic and design as well as the developer's

methods. In addition to learning how to utilize the existing software, the user of the code might potentially alter the design by adding new features to enhance the tool. (Dorodchi, & Dehbozorgi,2016). Users have the ability to modify the solution for their needs after understanding open source code. Martin (2013) also noted that as many OSS projects employ hundreds of developers globally, they are better able to keep up with emerging technological developments. With so many people contributing to these initiatives, productivity is increased while the requirement for technical know-how and training to work with them is reduced. Thus, open source software could aid students in learning how to modify existing scripts in accordance with specifications. As a result, open source motivates pupils to create as well as organize and carry out ongoing improvements (Burdge,2016).

Many educators have thought about using open source (OS) and free and open source software (FOSS) in education in general and computer science education in particular. For instance, Dionisio (2007) address the benefits of and trends in the usage of open source in undergraduate computer science teaching. Software engineering and development is one of these disciplines. The majority of undergraduate students always create their programs (and algorithms) from scratch while working alone, which is completely at odds with the manner that businesses typically build software. In other words, students typically do not work on another people's code.

As a result, they could encounter additional difficulties when they first enter the workforce and are assigned to a group of developers who are working with legacy codes. On the other hand, in terms of the quantity of resources used and the number of lines in the code, industrial initiatives have substantially greater code sizes than academic ones. For recent computer science grads, this mismatch could lead to more issues at work. We firmly believe that incorporating open source into software engineering courses infuses powerful features from the realm of professional software engineering to address a simple solution to the aforementioned problems. (Dorodchi, & Dehbozorgi,2016).

Changes in technology have had a rapid impact on the education sector, and technology is now pervasive in our daily lives. It has an impact on social interaction, online gaming, and learning most significantly. There are numerous software programs that can be utilized to assist the curriculum, including open source software, which comes in many different formats. For pupils, it might make exercises simpler. Any source, including the internet, can be credited. Teachers and students are far more aware of adopting free software today than they were a few years ago.

According to David Goodrum (2018), director of academic technology and information services at Oregob State University's campus technology, personalized instruction, new collaboration models, and a variety of innovative learning strategies are just a few of the ways that digital education is generating new learning opportunities as students engage in online and digital environments. Open source software is not intended to take the role of educators. Instead, the goal is to foster a broad atmosphere for learning and open doors to fresh encounters that inspire ideas. It transforms the learning atmosphere in the classrooms to one that is more collaborative. Teachers come up with inventive ways to educate their students new ideas and concepts in various contexts. The use of these tools by a teacher is very beneficial. To pique their students' interest and attention, teachers used a variety of reasons, including multi-media presentations.

According to Dorodchi, & Dehbozorgi (2016), open source software is simple to use and is available online for free download. It's fantastic to use open source software in education, such as Impress, which may be used to create straightforward presentations. Technology is more than just laptops, computers, telephones, and tablets, as we like to think of them. The use of technology has a significant impact on both students and teachers. Without technology, we would find it difficult to quickly adapt to our society's rapid change. It is allowing us to become more independent. With the ongoing developments, students can progress in the many educational chances. Students may readily obtain the material, which is quite useful for them as it is only a click away and contains all the information required. By using open source teaching methods, students can gain specific literacy skills. Due to advancements, the old educational system is already losing ground. Learning, however, is made simple and extremely advantageous for both teachers and students in our modern educational system.

2.3 collaborative learning

Rapid technological advancements have simplified distance learning (McBrien et al., 2009). The ability to utilize a computer connected to a network, which provides the option to learn from anywhere, anytime, in any rhythm, with any means, is shared by the majority of the words (online learning, open learning, web-based learning, computer-mediated learning, blended learning, for example) (Cojocariu et al., 2014). Flipped classrooms and blended learning are learning environments that combine in-person lectures with technology to maximize students' learning potential. Students can learn at anytime, anyplace, and gain new abilities that will help them learn for the rest of their lives. The government is also aware of the rising significance of online education in today's fast-paced society. A technology that can help the teaching-learning process be more student-centered, inventive, and flexible is online learning. "Learning experiences in synchronous or asynchronous environments using various devices (e.g., mobile phones, laptops, etc.) with internet connection" is how online learning is defined. Students can learn and interact with teachers and other students anywhere (independently) in these settings (Singh & Thurman, 2019). In contrast to asynchronous learning environments, which are poorly structured, synchronous learning environments have students participate in live lectures, real-time interactions between teachers and students, and the potential for quick feedback.

Many institutions all around the world have completely digitalized their operations due to the pressing demand of the moment. In the middle of this confusion, online education is emerging as the victor. Therefore, at this point, improving the quality of online teaching and learning is essential. The number of Chinese institutions offering courses online has skyrocketed since the Covid-19 epidemic. Normal classrooms were transformed overnight into online classrooms, which means that educators had to change their entire pedagogical strategy to address the changing market realities. In these trying times, the question is not so much about whether or whether online teaching and learning techniques can deliver high-quality education as it is about how academic institutions will be able to implement online learning so widely (Carey, 2020). Learning materials are available through various learning systems and forums rather than in the form of live lectures or seminars in such a learning environment. (Basilaia

et al., 2020). In such a setting, instant feedback and prompt action are not possible (Littlefield, 2018). There are numerous opportunities for social engagement during synchronous learning (McBrien et al., 2009).

E-learning has started to gain popularity in India during the past few years. Massive Open Online Courses are offered through a variety of sites at reasonable prices for students. Many Indian institutions were still wary of online teaching and learning. The difficulties brought on by the Corona Virus outbreak, however, exposed everyone to a brand-new realm of online education and remote teaching. Although certain platforms, like Google Hangouts, Skype, Adobe Connect, Microsoft Teams, and a few others, were used by instructors to partake in remote teaching, ZOOM came out on top. Additionally, in order to run teaching-learning programs smoothly, students were given the correct directions for attending classes as well as a list of online etiquette (Saxena, 2020).

In light of the spread of this deadly virus, it is necessary to create online platforms where

(a) video conferencing with at least 40–50 students are feasible.

(b) discussions with students can be held to maintain an organic learning environment.

(c) internet connections are strong.

(d) lectures are accessible on mobile devices as well as laptops.

e) the ability to view previously recorded courses.

f) the ability to get immediate feedback from students.

The use of technology has expanded the scope of the educational system, and as new e-learning tools are developed daily, it becomes more difficult to design an efficient system. Numerous studies have been done in this area, and the findings have indicated a fairly dramatic change in just the last two decades. Distinct learning and teaching environments have different requirements for how faculty knowledge is transferred to students. Every teacher and faculty member nowadays is digitally literate and capable of using technology in the classroom for instruction in addition to many forms of

assessments, especially in the higher education sector. However, the difficulties arise when it comes to some particular types of learning environments, such collaborative learning environments, which involve multiple students working in groups. A variety of technologies are available to help such a teaching and learning environment. This study report emphasizes the necessity for a new framework because outdated systems require updating as technology develops and curricula change. In some ways, teaching is a creative endeavor where information is transferred to students through the arts. It is a teacher's responsibility to spread knowledge in the classroom using the most effective techniques. The teacher's job is to determine the needs of the students and any obstacles to learning they may be facing. Simulators are used in computer hardware instruction to help students comprehend it better by showing them how the hardware actually works from the inside out. Blended learning is utilized to improve the educational experience for students, where both theoretical and practical concepts must be incorporated (Hasan, Ali, & Hayat, 2015). help enhance the discovery learning process by allowing students to quickly perceive and understand examples GeoGebra is utilized for mathematical and statistical analysis, and other multimedia tools are integrated to improve students' learning experiences (GebreYohannes, Bhatti, & Hasan, 2016).

Few tried activity-based learning, where the teacher watched the effects of teaching and learning, to improve student engagement and learning experiences (Hayat, Hasan, Ali, & Kaleem, 2017). The ideal learning environment is one that encourages the finest teaching methods and maximizes student engagement.

To improve students' knowledge of foundational ideas, interactive technologies are used. Teachers can quickly adapt open source tools and improve the teaching and learning process by using games or technology-assisted learning, according to Naidu, Balushi, and Bhatia (2017). (Naidu, Singh, Harrasi, & Balushi, 2017). The literature review makes clear that technology and tools are crucial for knowledge transfer. Regardless of the learning method chosen, it is crucial that peers work together to create a collaborative learning environment in order to promote knowledge dissemination. This will result in a better learning experience. According to the connected study, there is a need to integrate the right tools with the process for choosing learning styles.

Long-term benefit is possible due to the inclusion of all levels of learning.

E-learning is supported by several arguments. Some of the defenses of online pedagogy include accessibility, cost, flexibility, learning pedagogy, lifelong learning, and policy. Online learning is believed to be easily accessible and capable of reaching even rural and isolated regions. It is seen as a somewhat more affordable kind of education due to the lower costs of travel, lodging, and institution-based education as a whole. Another intriguing feature of online learning is flexibility; students can arrange or manage their time to finish online courses.

2.4 Benefits of open source applications in education

Numerous and diverse advantages have driven the usage and development of open source software. This benefit has a variety of just plain practical concerns to philosophical and ethical considerations. For the purposes of this paper, we will focus on the following list of practical concerns, as outlined by Barahona (2000):

a) **Quality-**A software package made by a small group of developers or one made by thousands of people is more likely to be superior. As many developers and users are striving to increase the security of open source software as there are developing new features and improvements for those products. Open source software typically comes the closest to delivering what consumers desire since those users can influence its development. Users and developers create what they want and do it effectively, thus it is not the vendor's responsibility to provide users with what it believes they want. Technical superiority is often the main reason businesses pick open source software, according to at least one recent survey. (Adamu & Kuba.2020).

b) **Reliability**-The absence of flaws that could result in improper functioning, data loss, unexpected failures, or failure to satisfy relevant published standards—commonly referred to as "bugs"—makes open source software dependable. This is not to imply that issues with OSA are never encountered, but each issue is typically resolved quickly, a process that is unquestionably aided by the availability of

the source code. As a result, proponents of Open Source assert that applications have exceptionally quick time-to-fix qualities. A defect report is often required for closed-source applications, after which there is a delay while the vendor decides whether or not to release an updated version. Compared to an open source setup, users of closed-source applications are far more at the mercy of the vendor's internal procedures. (Adamu & Kuba.2020).

c) **Stability**-according to Adamu and Kuba (2020). vendors of proprietary applications might use a variety of strategies to induce more or less agreeable upgrades from their clients. Common strategies include switching to ostensibly newer and better file formats (which need the newer and better Application to read them) or discontinuing support and bug patches for earlier versions after a brief period. The issue for such Application users is that they have little to no control over that process and are left in the dark if they decide to stick with previous versions. While the worst consequences of vendor push can be lessened with OSA, this has ramifications for the business in terms of costs and management. If a company has access to the source code, it may decide to support an older version as appropriate, providing people more alternatives and choices. (Adamu & Kuba.2020).

d) **Audit ability**-The ability to audit an Open Source Application (any Application whose source code is published) is a little-known advantage. When the vendor makes claims about traits like security, lack of backdoors, adherence to standards, and adaptability in the face of future developments, closed-source applications oblige their customers to believe the vendor. Those claims remain nothing more than claims in the absence of the source code. Users of the Application can feel confident that there is a foundation for such assertions because writers made the source code available. Inspection by a third party is impossible without access to the source. (Adamu & Kuba.2020).

e) **Cost**-The majority of open source software is offered without any charges or royalties. Since there is no expense associated with the number of copies

used, unlike when a proprietary application is used, administrative overhead costs are dramatically reduced. Additionally, since there are no upgrading fees, there are cheaper administrative costs. Virtually no virus vulnerability means no need for virus scanning, no data loss, and no downtime. (Adamu & Kuba.2020).

3.0 RESEARCH METHODOLOGY

The design of the study is the strategy for carrying out the study. It is concerned with what kinds of data or information will be collected and how that data will be collected (Berg, 1995). Jen (2007) describes survey design studies as ones that record the nature, range, dimensions, and directions of actions, behaviors, attitudes, and other things relating to people or objects.

In order to learn more about the choices, attitudes, preferences, and perceptions of the people who the researcher is interested in, the researchers employed a descriptive survey study design, which involved input from a sample population. In the investigation, a mixed method approach was used. 180 staff members and students were purposefully chosen at random for the study at Zetech University, and a sample of 118 was taken. In the quantitative approach, the descriptive statistics were employed to display the distribution of scores using a few indices.

4.0 FINDINGS
4.1 Demographic Information

Table 1: Gender

What is your gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	.8	.8	.8
	Female	28	23.7	23.7	24.6
	Male	89	75.4	75.4	100.0
	Total	118	100.0	100.0	

According to table 1 above 75.4% of the respondents were male while 23.7% were females.

Table 2: Level of Education

Which is the highest Level of Education you have attained?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		2	1.7	1.7	1.7
	Certificate	20	16.9	16.9	18.6
	Degree	26	22.0	22.0	40.7
	Diploma	66	55.9	55.9	96.6
	Masters	4	3.4	3.4	100.0
	Total	118	100.0	100.0	

According to table 2 above 55.9% of the respondents had diplomas, 22% had degrees, 16.9% certificate while 3.4% had master's degree as their highest level of education.

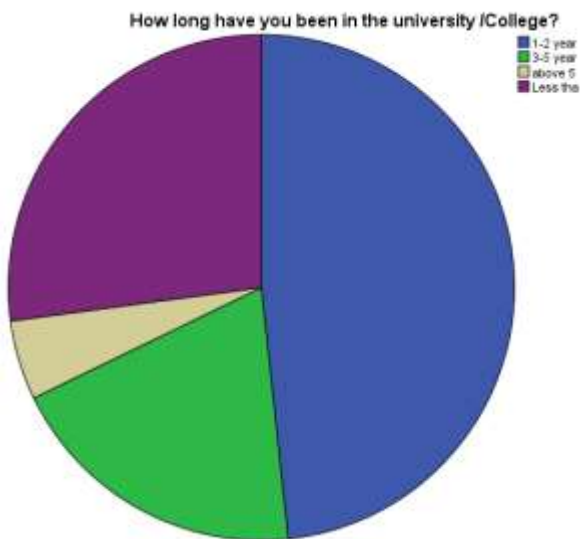**Duration in the university**

Figure 1: Duration of respondents in the university

According to figure 1 above majority of the respondents had been in the university for one or two years.

Table 3: Occupation in the university

What is your occupation within the university?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Staff	10	8.5	8.5	8.5
	Student	108	91.5	91.5	100.0
	Total	118	100.0	100.0	

According to table 3 above 91.5% of the respondents were students while 8.5% were staff.

4.2 Overview of open source software's usage and applications

Table 3: Type of software used by correspondents

Which type of software have you used?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	.8	.8	.8
	All	30	25.4	25.4	26.3
	Open source	80	67.8	67.8	94.1
	pirated	3	2.5	2.5	96.6
	Proprietary	4	3.4	3.4	100.0
	Total	118	100.0	100.0	

The majority of respondents, or 67.8%, utilized open source software, while 25.4% used all of it, 2.5% used pirated software, and 3.4% used proprietary software, according to table 3 above.

Table 4: Familiarity of open source applications

Are you familiar with open-source applications?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	11	9.3	9.3	9.3
	Yes	107	90.7	90.7	100.0
	Total	118	100.0	100.0	

Table 4 above shows that 90.7% of respondents were familiar with open source software, while 9.3% were not.

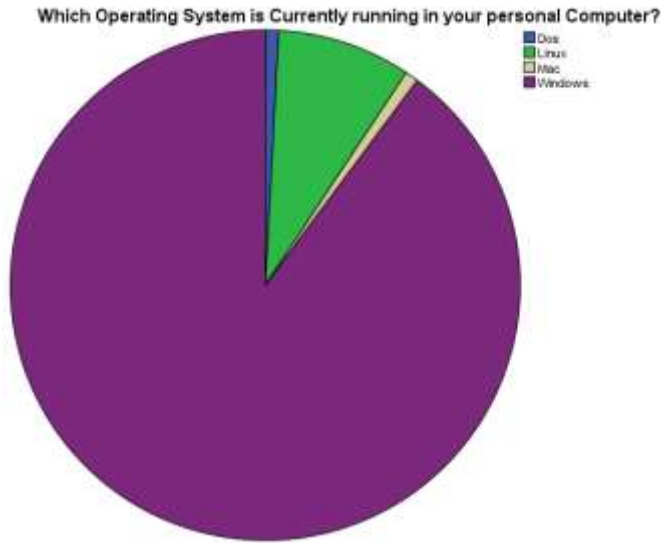*Type of operating system*

Figure 2: Type of operating system being used by respondents.

According to figure 2 above majority of the respondents were using windows-based operating system while the least used mac.

Table 5: Open source applications usage in teaching and learning computing courses

Do you believe that the usage of open-source applications in teaching and learning computing courses in the institution of higher learning is essential?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	2	1.7	1.7	1.7
	Yes	116	98.3	98.3	100.0
	Total	118	100.0	100.0	

Table 5 shows that 98.3% of respondents believed it was crucial to use open source software when instructing computer science courses, whereas 1.7% disagreed with the thesis.

Table 6: Universities using open source applications

Are you familiar with any university or organization that uses Open Source Software as their official use?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	.8	.8	.8
	No	38	32.2	32.2	33.1
	Yes	79	66.9	66.9	100.0
	Total	118	100.0	100.0	

Table 6 above shows that 66.9% of respondents were aware that colleges used open source software for official purposes, whereas 32.2% were not.

Table 7: Usage of open source applications in Curriculums

Are you familiar with any university that uses Open Source Software as a part of their curriculum?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		1	.8	.8	.8
	No	33	28.0	28.0	28.8
	Yes	84	71.2	71.2	100.0
	Total	118	100.0	100.0	

Table 7 above shows that 71.2% of respondents were aware that universities use open source software in their curricula, whereas 28% were not.

Table 8: Open source applications interaction with users

Which type of open-source application have you interacted with in learning?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		2	1.7	1.7	1.7
	BigBlueButton	39	33.1	33.1	34.7
	GitHub	37	31.4	31.4	66.1
	IDEs	6	5.1	5.1	71.2
	Linux	1	.8	.8	72.0
	Moodle	17	14.4	14.4	86.4

Open Admin	1	.8	.8	87.3
Open eLearning	15	12.7	12.7	100.0
Total	118	100.0	100.0	

According to table 8 above 33.1% of the respondents had interacted with the BigBlueButton (BBB),31.4% Github,14.4% Moodle, 12.7% open learning, 5.1% IDE's, while 0.8% had interacted with Linux and open admin.

4.3 Overview of open source software's usage and applications

Table 9: Open source applications usage

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Open Source Software is part of our teaching and learning process	2.5%	3.4%	8.5%	37.3%	48.3%
The study of open-source software should be compulsory for all computing courses in the university	3.4%	3.4%	17.8%	33.1%	42.4%
Universities should replace proprietary software with open source software for saving money on license renewal fees, up gradation charges etc	3.4%	5.1%	12.7%	40.7%	38.1%
I feel that open-source software has transformed the education sector	3.4%	3.4%	11.0%	33.1%	49.2%
I feel that teacher comes up in creative ways to teach their students using open FOSS	4.2%	5.1%	14.4%	38.1%	38.1%
Use of Open Source Software would provide a practical learning experience to the learners taking computing courses	3.4%	3.4%	11.0%	36.4%	45.8%
Course Outlines of all Computing Courses should have list of most relevant open source software useful in each course	3.4%	2.5%	10.2%	39.8%	44.1%
Institutions of Higher learning should have policy guidelines on use of Open Source Applications	3.4%	2.5%	12.7%	44.1%	37.3%
The Students and staff are fully aware of the available Open Source applications for use in teaching and learning	5.1%	6.8%	20.3%	37.3%	30.5%

Table 9 above indicates that 48.3% strongly agreed that using open source software is a component of our teaching and learning process, followed by 37.3% strongly agreeing, 8.5% neutrally agreeing, 3.4% disagreeing, and 2.5% strongly agreeing. All university computing courses should require the study of open-source software, according to 42.4% of respondents, while 33.1% agreed, 17.8% were neutral, and 3.4% disagreed. Universities should switch to open source software instead of proprietary software to save money on license renewal and upgrade fees, a position that was strongly supported by 38.1%, agreed by 40.7%, was neutral by 12.7%, and disagreed by 5.1% and 3.4%. Open-source software has significantly changed the educational landscape, according to 49.2% of respondents, 33.1%, 11%, and 3.4% of those who agreed strongly. 38.1% of respondents agreed, 38.1% strongly agreed, and 14.4% disagreed that teachers come up with innovative ways to teach their students using free and open source software. 5.1% and 4.2%, respectively, strongly disagreed. When asked if using open source software would give students enrolled in computing courses a real learning

experience, 45.8% strongly agreed, 36.4% agreed, 11% were neutral, and 3.4% disagreed. 44.1% strongly agreed, 39.8% agreed, 10.2% were indifferent, and 2.5% disagreed that the course descriptions for all computing courses should include a list of the most pertinent open source software beneficial in each course. When asked whether higher education institutions should have policies governing the usage of open source software, 37.3% strongly agreed, 44.1% strongly agreed, 12.7% were neutral, 2.5% disagreed, and 3.4% strongly disagreed. 30.5% highly agreed, 37.3% agreed, 20.3% were indifferent, 6.8% disagreed, and 5.1% strongly disagreed that the students and faculty are fully aware of the various Open Source apps for use in teaching and learning.

Table 10: Accessibility of Open Source Applications to potential computing educators & learners.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I believe that the FOSS is easily accessible to students and educators	4.2%	2.5%	23.7%	39.8%	29.7%
It is easy to conduct an audit of the FOSS due to the availability of codes.	5.1%	3.4%	16.1%	44.1%	31.4%
FOSS allows previously recorded classes to retrieved easily	4.2%	0.8%	18.6%	39.0%	37.3%
The university has provided the necessarily enabling environment for students and staff to access Open Source Applications	5.1%	2.5%	14.4%	46.6%	31.4%
Info-sessions should be provided by computing departments to sensitize them on use of open source applications in teaching and learning	4.2%	0.8%	8.5%	51.7%	34.7%
The ICT Infrastructure in the University has restricted us from use of Free open source software	4.2%	13.6%	29.7%	25.4%	27.1%
I believe that open-source applications are of high quality.	4.2%	3.4%	15.3%	44.9%	32.2%

Table 10 shows that 29.7% of respondents think that kids and teachers can readily use the FOSS, whereas 39.8% agreed, 23.7% were neutral, 2.5% disagreed, and 4.2% strongly disagreed. Due to the availability of the codes, doing an audit of the FOSS is simple, an idea that was strongly backed by 31.4%, agreed by 44.1%, neutral by 16.1%, disagreed by 3.4%, and severely disagreed by 5.1%. 37.3% highly agreed, 39% agreed, 18.6% were indifferent, 0.8% disagreed, and 4.2% strongly disagreed that FOSS makes it simple to retrieve previously recorded lessons. According to the survey, 31.4% of respondents highly supported the university's provision of the necessary enabling environment for staff and students to access open source software, while 46.6% agreed, 14.4% were indifferent, 2.5% disagreed, and 5.1% strongly opposed. Info-sessions should be offered by computer departments to educate faculty and staff on the use of open source software in teaching and learning, according to 34.7% of respondents who strongly agreed with this. In total, 51.7% agreed, 8.5% were indifferent, 0.8% opposed, and 4.2% strongly disagreed. 27.1% of respondents strongly agreed that the university's ICT infrastructure prevents us from using free open source software. 13.6% disagreed, 4.2% severely disagreed, 25.4% disagreed, 29.7% were neutral. Open-source software is of

good quality, according to 32.2% highly; 44.9% agree; 15.3% are neutral; 3.4% disagree; and 4.2% strongly disagree.

5.0 DISCUSSIONS

Open source software is not meant to replace educators in the classroom. Instead, the objective is to promote a diverse learning environment and offer doors to novel encounters that stimulate creative thought. It changes the classroom learning environment to one that is more collaborative. Teachers come up with creative ways to introduce new ideas and concepts to their pupils in a variety of settings. These resources are really helpful for teachers to use. Teachers used a range of techniques, such as multimedia presentations, to grab their students' interest and attention. Universities should switch to open source software instead of proprietary software to save money on license renewal and upgrade fees, a position that was strongly supported by 38.1%, agreed by 40.7%, was neutral by 12.7%, and disagreed by 5.1% and 3.4%. According to 49.2% of respondents, 33.1%, 11%, and 3.4% of those who strongly agreed, open-source software has drastically altered the educational landscape. 38.1% of those surveyed agreed, 38.1% strongly agreed, and 14.4% disagreed that educators should come up with creative ways to teach pupils using free and open source software.

On external platforms like Zoom, Google Meet, and others, synchronous learning is employed more frequently than on internal features. The culprit is Bigblue Button's infrequent use. Capacity is a crucial factor to consider while trying to improve the system's ability to run higher education. The Moodle platform's technical backbone needs to be improved. According to Naz and Khan (2018), a learning management system must offer trustworthy administration, tracking, reporting, and automation. When asked if using open source software would give students enrolled in computing courses a real learning experience, 45.8% strongly agreed, 36.4% agreed, 11% were neutral, and 3.4% disagreed. 44.1% strongly agreed, 39.8% agreed, 10.2% were indifferent, and 2.5% disagreed that the course descriptions for all computing courses should include a list of the most pertinent open source software beneficial in each course. The extensive use of external usage does not appear to have affected any of the processes for administration, tracking, reporting, or automation (Makruf et al.,2022). The ideal educational process depends on a variety of elements, including student and teacher digital literacy, teaching methods, student

interaction, student-faculty relationships, quick feedback, active learning, collaborative learning, technology application, and many others (Coman et al., 2020). Additionally, an important consideration is the usage of interactive tutorial films in instruction by including YouTube embed codes on Moodle (Nagy, 2018). Utilizing open source software is a part of our teaching and learning process, with 48.3% strongly agreeing to this statement, followed by 37.3% strongly agreeing, 8.5% neutrally agreeing, 3.4% disagreeing, and 2.5% strongly agreeing. According to 42.4% of respondents, all university computing courses should require the study of open-source software, while 33.1% agreed, 17.8% were neutral. Wambui et al. (2022) ascertains that using a variety of open source apps, many institutions of higher education have shifted from the outdated classroom model to online courses, as well as from the outdated offline evaluation method to an online one. Using online assessment tools, they are evaluating themselves. Online evaluation tools are nonetheless subject to these limitations. while compared to the norm, several measurement mistakes are reported while using online evaluation tools.

6.0 CONCLUSIONS

Universities all throughout the world are now dealing with new learning management requirements and cultures as a result of the Covid-19 pandemic. A new hope emerges in the form of digital platforms like web-based learning management. In order to ensure deployment and learning quality assurance, IAIN Surakarta created the Moodle-based learning (SiKulon) platform. According to the research's findings, online learning management is less effective, particularly in the areas of learning implementation and learning evaluation. However, learning is included in the high- or optimal-use planning. The paradigm for education must change to Education 4.0 in order to give innovatively productive education. To do this, both instructors and faculty members can benefit from a range of cutting-edge tools and technologies.

This study identified flaws in crucial learning management components. system, namely the application and assessment of learning. Many instructors continue to use systems besides Moodle for the application of learning, such as synchronous learning (virtual face-to-face learning), use Zoom, Google Meet, or another platform. For asynchronous learning, use Google Classroom, WhatsApp, or another platform. Three

primary criteria, including system quality, supporting infrastructure, and user capability, can influence this choice. These technologies can be utilized to record students' participation and engagement in the module both on and off the campus with the use of IoT and ontology (Mahmood et al., 2019; Sarker et al., 2019). Virtual learning environments can be utilized in conjunction with other blended learning environments to cater to a range of learner types (Hasan et al., 2019). Accordingly, it's important to maximize the utilization of the e-learning apps available by providing them with a variety of suitable support capabilities. Similar to the evaluation, the Moodle-based learning application's menu usage needs to be improved for both the system and the users (students and lecturers), especially when it comes to collecting students' work. By maximizing the functionality of the current systems, it is also necessary to increase the use of the evaluation or assessment features. Practitioners must be aware of the potential negative effects of using open source software while developing a product in order to be ready for them, anticipate them, and take the required steps to overcome them. The institutions ought to be linked to website which features a list of open source programs associated with many categories, including security, cloud computing, small enterprises, big data, games, etc. Aspiring computer science teachers' knowledge of open source programs will be improved as a result. As a part in its internal evaluation, an institution may undertake a comprehensive survey. Positive user views represent user expectations, but institutions must also consider performance expectations, effort expectations, social factors, and facility expectations.

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