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Developing Google Sites-assisted collaborative learning materials to learn quadratic function

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Abstract

This study was motivated by the need for teaching materials obtained from the results of questionnaire analysis, namely 69 out of 70 students stated that they needed interactive and fun website-based teaching materials. Students also experience difficulties in learning mathematics with the methods applied by teachers and material that is considered difficult, namely the quadratic function with a percentage of 70%. This study aims to develop website-based interactive teaching materials with a collaborative approach assisted by Google Sites that are valid and practical. The research used the ADDIE development model (Analysis, Design, Development, Implementation, Evaluation). The research subjects were students of class X-5 and X-3 SMA Negeri 1 Kasihan, while the research object was Funmath Quadratic Function website. Data were collected through interviews, observations, material and media expert validation questionnaires, and student response questionnaires in small and large class trials. The results showed that the Funmath Quadratic Function website teaching materials developed were very valid with a percentage of 86% according to material experts and 86.5% according to media experts. In addition, this teaching material is also very practical with a score of 88.6% in the small class trial and 95.18% in the large class trial. The results showed that this teaching material is very valid and practical, so it can help the process of learning mathematics on quadratic function material that is more interactive and fun. In this study, it is recommended to add a variety of content and interactive activities for better understanding of the quadratic function. In addition, training for teachers and students needs to be provided so that the use of the website is maximized. Periodic evaluation is also important to maintain the quality and relevance of teaching materials.

Keywords: collaborative approach, Google Sites, quadratic function, teaching materials

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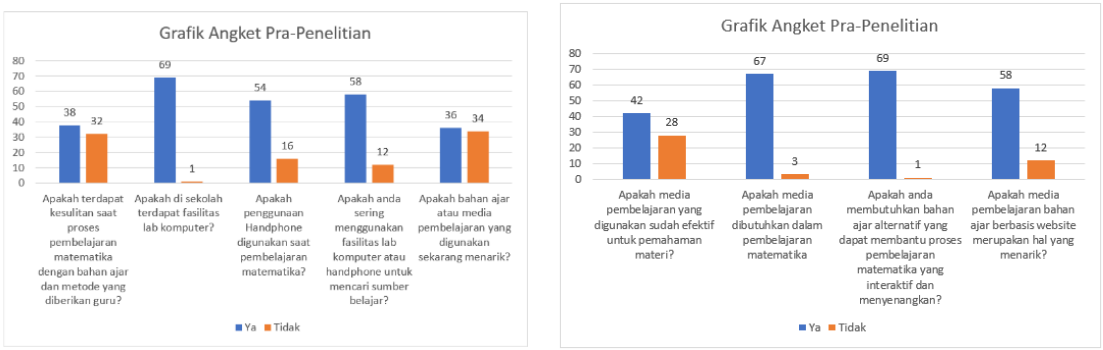
INTRODUCTION

Education in the era of globalization is progressing rapidly, marked by a shift from traditional learning methods to systems that are more connected to technology, such as the use of books that can now be accessed via the internet (Amadi, 2023). The transformation of educational technology in Indonesia aims to build a digital ecosystem in the educational environment, where this transformation process has brought various impacts on teaching and learning activities for both students and teachers (Alfiansyah et al., 2025). Innovating in the learning process is essential to support effective and relevant education. Innovation in learning is often applied to make the learning atmosphere more meaningful and enjoyable for students (Hapsari & Fatimah, 2021).

Figure 1. Results of questionnaire of mathematics material difficulties for Class X SMA Negeri 1 Kasihan

Based on the results of preliminary observations and material needs questionnaires in Figure 1, conducted at SMA Negeri 1 Kasihan, it was found that as many as 70% of students said that quadratic function material was the most difficult material from statistics and probability material stated by the teacher in the interview. So, to facilitate the learning process, teaching materials are needed that can facilitate teachers and students in understanding the quadratic function material (See Figure 2).



(a) (b)

Figure 2. Pre-research questionnaire results of teaching material needs of Class X Students of SMA Negeri 1 Kasihan

The results of the questionnaire show that 38 out of 70 students of Class X SMA Negeri 1 Kasihan admitted to having difficulty in learning mathematics with the teaching materials and methods used by the teacher at this time. The school has provided computer laboratory facilities and students are accustomed to using digital devices such as mobile phones in the learning process, the existing teaching materials are still considered less attractive and need to be improved to be more effective and can help understand the material well. The results of the pre-research questionnaire show that the majority of students think teaching materials are needed and hope for new innovations that make math learning more interactive and fun. Most students are also interested in website-based teaching materials, so the development of website-based digital teaching materials is a great opportunity to increase motivation and quality of learning in the classroom.

Based on the results of interviews with teachers and students of class X SMA Negeri 1 Kasihan, learning mathematics so far is still dominated by individual activities, such as explaining the material by the teacher and working on problems independently. The use of media such as Power Point and LKPD

has indeed been done, but there are still many students who have difficulty understanding the material due to lack of interaction and cooperation in the learning process. The classroom atmosphere also tends to be monotonous and less interactive because group learning is rarely applied. Therefore, it is necessary to develop teaching materials with a collaborative approach that encourages students to actively work together in groups. Through a collaborative approach, learners can not only exchange ideas, but can also improve their critical thinking skills through discussion activities, problem solving, and reflection together (Aulia et al., 2023).

This study aims to develop mathematics teaching materials on quadratic function material using the Google Sites platform for class X students of SMA Negeri 1 Kasihan, and test the validity and practicality of the products produced. The teaching materials developed will be adjusted to the independent curriculum, equipped with material, sample problems, practice problems, and multimedia integration such as images, videos, audio, geogebra applications, and interactive games. With this teaching material, it is hoped that students can learn more interactively and enjoyably, and teachers can more easily deliver material in a structured and efficient manner.

Theoretically, the results of this study are expected to be a reference and inspiration for educators and other researchers in developing digital-based interactive teaching materials in mathematics learning. Practically, the development of teaching materials is expected to increase students' motivation, involvement, and understanding of quadratic function material, as well as facilitate teachers in the learning process. Thus, this research is expected to make a real contribution in improving the quality of mathematics learning in the digital era, especially at SMA Negeri 1 Kasihan.

RESEARCH METHOD

This research uses the Research and Development (R&D) method with the ADDIE (Analysis, Design, Development, Implementation, Evaluation) development model (Salsabila et al., 2023). The ADDIE model was chosen by the researcher with the argument that the systematic development is interrelated at each stage with the research needs relatively easy to adapt and suitable for producing products in the form of valid and practical digital teaching materials. The ADDIE model is a systematic approach that requires analysis of consistency at all stages and how each stage is interconnected (Hidayat & Nizar, 2021), as presented in Figure 3.

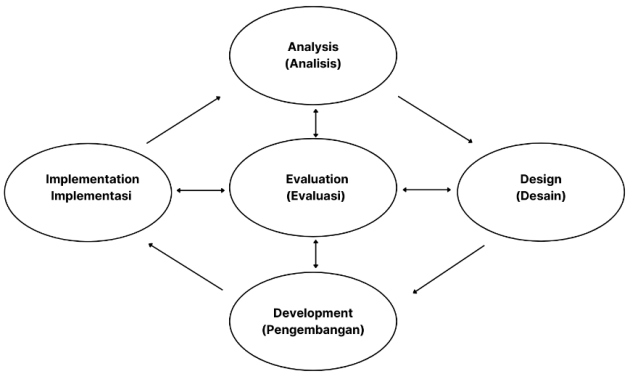


Figure 3. Stages of the ADDIE model

At the analysis stage, researchers identified needs through observations, interviews, and distributing questionnaires to teachers and students. Furthermore, at the design stage, researchers designed website-based teaching materials using flowcharts and storyboards, then developed by utilizing Microsoft Word, Canva, and Capcut applications as well as several websites to support the visualization of teaching materials. The development stage is carried out by making teaching materials according to design, involving validation and input from expert lecturers to ensure product quality. After the media is validated, the implementation stage is carried out in small and large classes. Finally, at the evaluation stage, researchers make revisions and improvements based on the results of trials and input, so that the teaching materials developed can be used effectively. in learning.

In this study using two types of data, in Tegeh, et al (2014) data based on its nature is grouped into qualitative and quantitative data. Qualitative data is obtained from reviewing the results of questionnaires, interviews with test subjects, and input and suggestions from experts or validators. Quantitative data is obtained from validation instruments in the form of media validation questionnaires, material validation questionnaires, and questionnaires to measure students' responses to the attractiveness of the teaching materials developed. “Analysis techniques for processing data obtained from questionnaires of Material Experts and Media Experts in the form of percentages” Tegeh, et al (2014). The following are the expert assessment criteria found in Table 1, using a Likert scale with 5 intervals.

Table 1. Expert assessment criteria

Score	Criteria
5	Very Good
4	Good
3	Fair
2	Poor
1	Very Poor

Source: (Islam & Fahmi, 2018)

From the data information that has been collected, calculations can be made using the following formula.

$$X = \frac{F}{N \times I \times R}$$

Description: X = Percentage of validity
F = Total number of respondents' answers
N = Highest score in the questionnaire
I = Number of questions in the questionnaire
R = Number of respondents

Then after knowing the results of the calculation of the percentage of validity, it will then be interpreted based on Table 2.

If all aspects assessed in the questionnaire show a value> 60%, then the media can be categorized as valid. This indicates that in general, material experts and media experts gave a positive response to the teaching materials evaluated, thus meeting the predetermined eligibility criteria.

Tabel 2. Interpretation of media validity

Percentage	Category
$80\% < X \leq 100\%$	Very Valid
$60\% < X \leq 80\%$	Valid
$40\% < X \leq 60\%$	Less Valid
$20\% < X \leq 40\%$	Invalid
$0\% < X \leq 20\%$	Very Invalid

Then to calculate the students' questionnaire data is done using the equation found in Table 3.

Table 3. Interpretation of Practicality

Percentage	Category
$80\% < X \leq 100\%$	Very Practical
$60\% < X \leq 80\%$	Practical
$40\% < X \leq 60\%$	Less Practical
$20\% < X \leq 40\%$	Not Practical
$0\% < X \leq 20\%$	Very Not Practical

If all aspects assessed in the learner questionnaire get> 60%, then the media can be categorized as practical. This indicates that students generally assess the teaching materials as easy to use and understand in the learning process.

RESULTS AND DISCUSSION

This research and development resulted in the Funmath Quadratic Function website, which is a math learning product in the form of a website that contains material about Quadratic Functions developed through the Google Sites platform. The Funmath Quadratic Function website can be accessed through a smartphone, laptop, or computer connected to an internet connection via the link (https://s.id/funmathfungsikuadrat). The development of this math learning website uses the ADDIE model which has the following stages.

Analysis

The analysis in this study is in line with (Harefa et al., 2023), namely three factors that need to be studied, including learner analysis, material analysis, and analysis of teaching materials with the following explanation.

Learner analysis

This stage aims to identify obstacles in the learning process through interviews with teachers and questionnaires to students. The results show that students have difficulty with the Problem Based Learning (PBL) model, which is monotonous and carried out individually. However, learning is supported by computer laboratory facilities, wifi, and the use of mobile phones with teacher permission according to Merdeka Curriculum.

Material analysis

Analysis of quadratic function material is carried out to determine learning outcomes (CP) and learning objectives (TP) in accordance with the independent curriculum and implemented in the Quadratic Function Fuhmath website. The General Learning Outcomes of Phase E (Class X) in the independent curriculum,

elements of Algebra and Functions (Quadratic Functions) are "Students are expected to be able to solve problems related to equations and quadratic functions (including imaginary roots)". The sources used to determine the Learning Objectives for Quadratic Function Material are as follows:

(1) Mathematics student book for SMA/SMK Grade X (Susanto et al., 2021),
(2) Mathematics teaching module for quadratic function (Yuzar, 2022),
(3) General mathematics learning module for SMA (Sutisna, 2020)

The learning objectives for quadratic function teaching materials used in teaching materials are:

(1) Students can identify the general form of quadratic functions.
(2) Students can determine the intersection point of the graph of a quadratic function on the X and Y axes.
(3) Students can calculate the vertex of a quadratic function.
(4) Students can draw the graph of a quadratic function.
(5) Students can determine the discriminant based on the root type of a quadratic function.
(6) Students can construct a quadratic function.
(7) Students can solve problems with quadratic functions.

Analysis of teaching materials

In an interview with a mathematics teacher, it was stated that so far the learning of mathematics uses Learner Worksheets (LKPD) and also Powerpoint (PPT) which is displayed using a projector in the classroom. Teachers recommend that participants still need more interactive teaching materials to help students in learning mathematics, especially with the rapidly developing technology, so that it can be utilized for practical and fun learning. With the existing facilities at SMA Negeri 1 Kasihan, such as computer laboratories and wifi access, which can be optimized to support technology-based learning. Furthermore, the results of the pre-research questionnaire of students showed a high interest in website-based learning media that can be accessed via mobile phones. This indicates that the use of websites as teaching materials will be relevant to the interests and habits of students, and can be a solution to present materials that are more interesting, interactive, and fun. Thus, teaching materials developed through the Funmath Quadratic Function website are expected to be an effective and attractive solution for students to achieve the expected competencies.

Figure 4. Flowchart of Funmath quadratic function website

Design

The design planning of the Quadratic Function Funmath website includes three main stages. First, the flowchart is used to visually describe the systematics and workflow of the website, making it easier for developers to understand the structure and navigation between pages. The following is the flowchart design of the Quadratic Function Funmath website (See Figure 4).

Second, a storyboard is created as a rough sketch for each page of the website so that the layout and content are neatly arranged and structured, including menu pages, instructions, teaching materials, geogebra, games, creator profiles, references, and feedback.

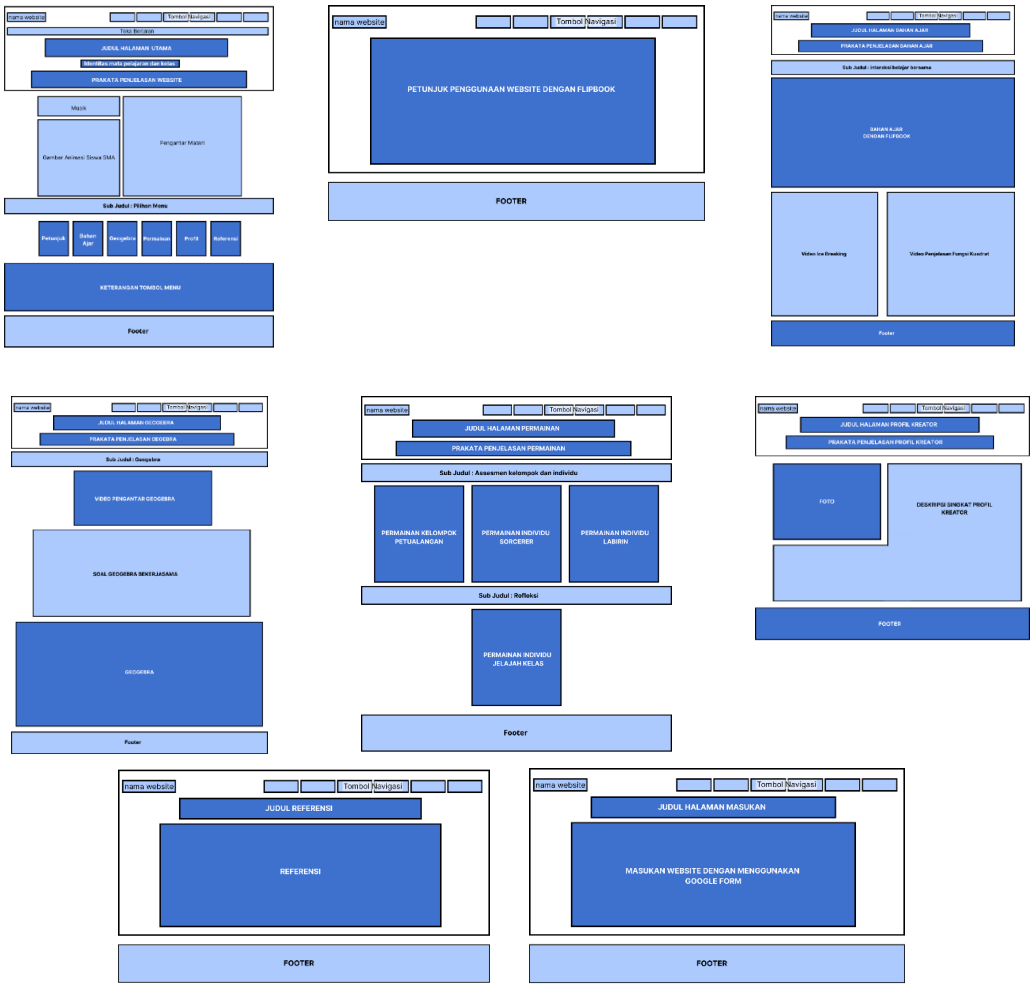


Figure 5. Storyboard of the Funmath quadratic function website

Third, the display design organizes the visualization of each page, starting from the main menu that contains complete information and navigation, the instruction page with PDF flipbook, teaching materials equipped with supporting videos, geogebra features for quadratic function graph exercises, interactive games for assessment and reflection, creator profiles, material source references, to the input page connected to Google Form for user feedback. All these elements are designed to create an interactive, structured, and engaging learning experience for learners.

Figure 6. Design of Funmath quadratic function website display

Development

This stage includes the implementation of the learning media product design that has been made. Here are some steps in the development process.

Product manufacturing

Product development began with collecting materials using Microsoft Word and designing teaching materials and explanation videos through Canva. The Quadratic Function Funmath website was then created using Google Sites, following the flowchart and storyboard design to organize the menu, references, teaching materials, geogebra, games, creator profile, and feedback. The ice-breaking video was edited with Capcut, while the teaching materials and instructions were presented in digital flipbook format, and once all elements were completed, the website was published for wider access.

Product validation

The product validation stage aims to obtain an assessment and input so that the product developed is feasible and valid before being tested. Media expert

validators are a lecturer at Universitas Ahmad Dahlan and a teacher at SMA Negeri 1 Kasihan. Media experts are selected based on expertise in the field of learning media to provide an objective assessment of the feasibility of the media. The results of the media expert assessment are in Table 4.

Table 4. Media expert assessment results

No	Aspect	Validator 1	Validator 2	Total	Percentage	Category
1	Display	52	58	110	84.61%	Very Valid
2	Usage	20	25	45	90%	Very Valid
3	Utilization	8	10	18	86.5%	Very Valid
Total average		80	93	173	86.5%	Very Valid

Based on the table, the average value of the calculation results of media expert 1 and media expert 2 as a whole is 86.5%. In accordance with the table, it can be interpreted as being in the range of 80% < X ≤ 100%. Thus, the results of the media validation assessment show that the quadratic function funmath website is included in the Very Valid category.

Table 5. Material expert assessment results

No	Aspect	Validator 1	Validator 2	Total	Percentage	Category
1	Introduction	14	15	29	96,67%	Very Valid
2	Content	25	27	52	86,67%	Very Valid
3	Learning	43	52	95	86,36%	Very Valid
4	Summary	12	10	22	73,3%	Valid
5	Discussion	8	9	17	85%	Very Valid
Total Average		102	113	215	86%	Very Valid

Material expert validators were chosen because of their expertise in learning materials to evaluate the suitability, accuracy, and completeness of the quadratic function material according to learning objectives and curriculum standards, namely a lecturer from Universitas Ahmad Dahlan and a teacher from SMA N 1 Kasihan.

Figure 7. Small group testing

Based on the table, the average value of the calculation results of material expert 1 and material expert 2 as a whole is 86%. In accordance with the table, it can be interpreted as being in the range of 80% < X ≤ 100%. Thus, the results of the material validation assessment show that the Funmath website quadratic function is included in the Very Valid category.

Implementation

The product implementation stage was carried out through two trials, namely small class and large class trials. The small class trial was conducted on Tuesday, April 15, 2025, involving 10 students from class X-5 SMA Negeri 1 Kasihan who were randomly selected to try the Quadratic Function Funmath website, check all elements, and provide feedback (See Figure 7).

The results of the learner response questionnaire can be seen at the link: https://s.id/RekapitulasiUjiCobaKelasKecil. The following small class trial calculations are in Table 6.

Table 6. Small group trial assessment results

No	Aspect	Percentage	Category
1.	View	88.6%	Very Practical
2.	Material	88%	Very Practical
3.	Benefits	91%	Very Practical
	Average	88.6%	Very Practical

Based on the results of the small class trial, the Funmath Quadratic Function website obtained an average percentage of practicality of 88.6%, which is included in the "Very Practical" category (80% < X ≤ 100%). This shows that the website is considered easy to use, useful, and attractive by students. Although there are some suggestions for improvement, overal this website has met the criteria of practicality and is suitable for use in learning mathematics in class X.

Figure 8. Large group testing

After making improvements based on feedback, a large class trial was conducted on Monday, April 21, 2025, involving 32 students from class X-3 to test the effectiveness, practicality, and wider response through Google Form questionnaire assessment (See Figure 8). The results of these two

trials became the basis for evaluating and improving the product so that the website can be used optimally in learning.

The results of the learner response questionnaire in the large class trial are contained in the link and can be recapitulated as seen in Table 7.

Table 7. Large group trial assessment results

No	Aspect	Percentage	Category
1.	Appearance	95.25%	Very practical
2.	Material	95%	Very practical
3.	Benefits	95.62%	Very practical
	Average	95.18%	Very practical

Based on the results of the large class trial displayed in Table 7. Based on the results of the large class trial, the Funmath Quadratic Function website obtained an average percentage of practicality of 95.18%, which is included in the "Very Practical" category (80% < X ≤ 100%). This shows that the website is considered very easy to use, useful, and attractive by students. Thus, this website-based teaching material has fulfilled the practicality aspect and is suitable for use in learning.

Evaluation

This evaluation stage aims to provide input and improvements to the product during the development process so that the learning media is more optimal. The evaluation stage of quadratic function learning website products is carried out in stages. First, the evaluation is carried out by the supervisor who provides general input related to the presentation of the website and assessment instruments. Furthermore, media expert and material expert validators conducted in-depth assessments of several aspects. In addition, mathematics teachers were also involved as media and material expert validators to provide a valid perspective on the teaching materials developed. After validation by experts, the product evaluation was tested in two stages, namely small group testing and large group testing.

CONCLUSION

The development of Funmath Quadratic Function website-based teaching materials uses the ADDIE model which includes the stages of analysis, design, development, implementation, and evaluation. This website was validated by material experts with an average value of 86% and media experts with an average value of 86.5% with very valid results. While the practicality test was through a small class trial of 88.6% and a large class of 95.18%, so that overal it obtained an average practicality of 91.89% and entered the very practical category. Funmath Quadratic Function website is considered interactive and fun to support math learning, especially quadratic function material in class X SMA Negeri 1 Kasihan. Thus, this teaching material is suitable for use as a collaborative-based interactive and fun teaching material in schools. In this study, it is recommended to add a variety of content and interactive activities for better understanding of the quadratic function. In addition, training for teachers and students needs to be provided so that the use of the website is maximized. Periodic evaluation is also important to maintain the quality.

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