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Development of Interactive Learning Media Using Google Sites for Thermochemistry Courses

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Abstract

Interactive learning media is essential in enhancing student engagement and understanding, particularly in complex subjects like thermochemistry. Google Sites offers a platform to create accessible and interactive educational resources tailored to specific course needs. This study aims to develop, validate, and evaluate student responses to Google Sites-based interactive learning media for a thermochemistry course. The development process followed the analysis, design, development, implementation, and evaluation (ADDIE model). However, this research was limited to the development stage. Validation was conducted on material and media aspects, each reviewed by two validators. Data collection instruments included questionnaires for validation and student responses, involving 32 second-year Chemistry Education students who had previously studied thermochemistry concepts. Validation results yielded scores of 0.94 for the material aspect and 1.00 for the media aspect, indicating excellent validity. Student responses to the media averaged 83%, categorized as very good. The findings suggest that Google Sites-based interactive learning media effectively supports thermochemistry learning, offering a practical and engaging tool for educators and students. Further development and broader implementation of this media could enhance learning outcomes in similar scientific disciplines.

Keywords: google sites, learning media, thermochemistry course

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1. Introduction

Thermochemistry is often regarded as a challenging subject due to its heavy reliance on formulas and calculations, which makes it less appealing to some students. Murniati, et al. (2018) said that usually courses that are considered difficult will be avoided or will not be studied further by students. Thermochemistry is calculated and contains concepts and has a relationship between concepts so that participants' critical thinking skills are needed to be able to understand the material (Selian, 2020). According to Zakiyah, et al. (2018), Thermochemistry learning requires students to understand the concepts underlying thermochemistry, which is the concept of stoichiometry. Therefore, educators need to think of the right solution so that students can understand the material more easily. The learning process of thermochemistry requires appropriate supporting learning media in delivering the material (Nuryanto, et al., 2015).

According to Ismawati et al. (2021), learning media serve as tools that help stimulate students' thoughts, emotions, skills, and attention during the teaching and learning process in the classroom. These media can enhance the student learning experience in teaching, ultimately leading to improved learning outcomes (Purwati, et al. 2014). The learning outcomes obtained by students are included in the cognitive aspect which emphasizes how the process to make the best of the ability of the rational elements of students (Sutarto, 2017). Learning media is certainly presented in a more interesting form so that students not only should students listen to explanations from teachers, but they should also engage in other activities, such as observing, doing, solving problems, completing games or quizzes, and others. In addition, the role of learning media, particularly audio-visual media, goes beyond merely transmitting messages; it also aids in simplifying the reception of complex information, ensuring that the communication process is smooth and free from distortion, as noted by Rosyidi (2015).

The needs analysis of first-year students on the topic of thermochemistry shows that the learning media used are whiteboards and e-modules. The whiteboard allows for a systematic presentation of material; however, the clarity of the writing is often hindered by messy handwriting and the seating arrangements of students. Meanwhile, the e-modules encourage interaction and critical thinking through group assignments, but it is less interactive and sometimes difficult for students to understand during presentations.

Some first-year students find thermochemistry difficult to understand, as reflected in an average post-test score of 55.3. Additionally, there is a desire among students to use interactive learning media. According to Darmawan (2012), interactive media serve as more effective tools for understanding, not just as learning materials, and can enhance student engagement using images, text, videos, audio, and animations (Rohmah & Bukhori, 2020). Many students believe that their understanding of thermochemistry can be improved with the use of interactive media, and Google Sites is recommended as an appropriate platform for this purpose.

This media was chosen because it has not been Google Sites is an online application for creating websites that consolidate information in one place (Mardin & Nane, 2020). This platform was chosen to support thermochemistry learning with interactive features, such as learning materials, videos, and games. Additional features also allow lecturers to use Google Sites as a learning evaluation tool.

Divayana, et al (2016) state that Google Sites are very user-friendly, particularly for supporting learning by maximizing features such as Google Docs, Sheets, Forms, Calendars, Awesome Tables, and more. Research conducted by Yuliana et al. (2021) reveals the analysis of student response questionnaire data regarding the use of Google Forms, which many students agree to the use of Google Forms as an evaluation tool seen from test questions and student response questionnaires. In addition, it can also be seen in the results of research conducted by Syakiroh (2021) that there is data on the increase in the average score from 72.59 to 85.36, which is 17.5% out of 100 which is included in the category quite effective for improving student achievement. When assessed for its feasibility, Google Sites learning media received an average score of 4.60 in the feasibility test, placing it in the "very feasible" category for use in the learning process, according to research conducted by Nugroho & Hendrastomo (2021).

Google Sites can also be a solution to the different learning styles of each person which are visual learning styles (seeing), auditorial (hearing), and kinetic (moving, working, and touching) (DePorter & Hernacki, 2015). According to DePorter and Hernacki (2015), learning styles are essential for improving performance in various aspects of life, as they influence how individuals absorb information and their overall achievements. This aligns with research conducted by Dewi et al. (2023), which found that differentiated interactive

learning media utilizing Google Sites meets the criteria for validity, practicality, and effectiveness in enhancing students' mathematics learning outcomes.

Based on the explanation above, to help students learn thermochemistry, researchers are interested in developing Google Sites: a platform for interactive thermochemistry learning. Therefore, this study's goals are: (1) to describe how to develop; (2) to determine the validity; and (3) to student responses to Google Sites-based thermochemistry interactive learning media.

2. Research Method

This research employed Research and Development (R&D) purposed by Branch (2009). This model comprises five stages which are analyze, design, develop, implement, and evaluate. However, the research conducted was limited to the development stage. This is predicated on the idea that, aside from not trying to ascertain the efficacy of the developed items, the research concentrates mostly on the process of product development. The details of each stage can be seen in Figure 1. The following are details of the process carried out in this development research.

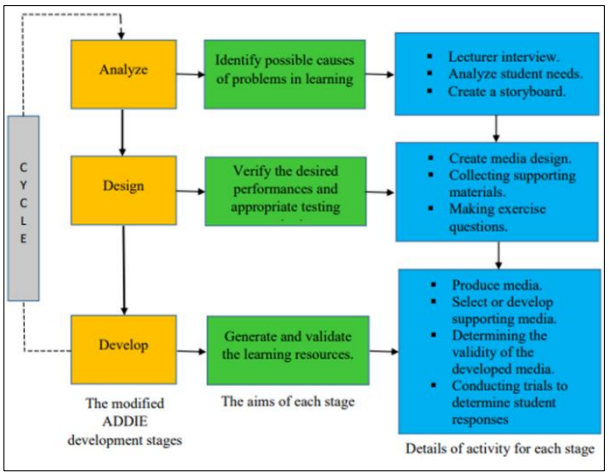


Figure 1. Diagram of the Three Stages of the ADDIE Model Development Research
(Source: Modification of Branch (2009) Model)

2.1. Participants

The participants in this study were 32 first-year students from the Chemistry Education program in the Department of Mathematics and Science Education at University Tanjungpura, Indonesia.

2.2. Data Collection

Data collection methods in this development research include: (1) direct communication was carried out through interviews with lecturers and students, and the insights gained from these interviews were used to identify problems and suggest solutions to resolve them, (2) the measurement technique is to assess the validity of the media that has been made from the material and media aspects according to the validation sheet that has been made, (3) indirect communication was employed through the use of a questionnaire to assess student needs and gather their responses regarding interactive learning media based on Google Sites. The instruments utilized for data collection in this study included, validation sheets, needs analysis questionnaires, and response questionnaires. The response questionnaire consists of five sub-aspects including (1) content, (2) learning, (3) language, (4) visual communication, (5) software engineering.

2.3. Data Analysis

The data analysis techniques employed in this study consist of two types, which are qualitative data analysis and quantitative data analysis. (1) Qualitative analysis is utilized to process data that includes feedback and suggestions from media validators, material validators, and students, (2) Quantitative analysis is used to process data in the form of scores obtained from learning media validation sheets given to media and material validators and scores obtained from student response questionnaires.

Scoring guidelines use the Likert scale. The Likert scale used consists of four levels by eliminating doubtful (neutral) answers. In general, Likert scales have five to seven answer options. The Likert scale with four alternative answers is considered the most appropriate because this Likert scale can facilitate the

process of concluding. The research results obtained can be close to 100% accurate, by not giving the answer option "neutral" answer options which are feared will confuse the process of drawing research conclusions (Handayani, 2015). In the questionnaire. The answer options and scores used in the validation and response questionnaires can be seen in Table 1.

Table 1. Score Guidelines

Assessment	Description	Score
SA	Strongly Agree	4
A	Agree	3
D	Disagree	2
SD	Strongly Disagree	1

The validation of Google Sites-based thermochemistry interactive learning media uses research instruments according to Gregory. Content validity analysis on expert assessment using the Gregory formula with the mechanism: 1) on the instrument that has been made, the experts assessed of each item with a "score 1 or 2 (irrelevant), score 3 or 4 (relevant)", 2) the results of the expert assessment were tabulated into a cross-tabulation matrix 2 x 2 (Gregory, 2015). The cross-tabulation is presented in Table 2. Validation was conducted by two chemistry education lecturers who are experts in the field of content, along with two chemistry education lecturers who specialize in media.

Table 2. Gregory Index Cross Tabulation

		Expert 1	
		Not Relevant (Score 1-2)	**Relevant (Score 3-4)**
Expert 2	**Not Relevant (Score 1-2)**	A	B
	Relevant (Score 3-4)	C	D

Based on Table 2, the researcher calculates the content validity using the Gregory formula as follows Eq. (1).

$$\text{Content Validity (CV)} = \frac{D}{(A+B+C+D)} \text{ x } 100\% \quad (1)$$

Description:
A = Not relevant from experts 1 and 2
B = Relevant from expert 1, irrelevant from expert 2
C = Not relevant from Expert 1, relevant from Expert 2
D = Relevant from experts 1 and 2

Furthermore, the level of validity is determined using the criteria or validity coefficient as in Table 3.

Table 3. Content Validity Coefficient Criteria

Coefficient	Validity
0.80 – 1.00	Very high
0.60 – 0.79	High
0.40 – 0.59	Medium
0.00 – 0.39	Low
0.00 – 0.19	Very Low

The data processing method in the student response questionnaire to Google Sites-based thermochemistry interactive learning media is to calculate the accumulated scores of students who choose SA, A, D, and SD criteria on each positive and negative question according to Table 4.

Table 4. Response Questionnaire Score Guidelines

Category	Score	
	Positive Statement	**Negative Statement**
Strongly Agree (SA)	4	1
Agree (A)	3	2
Disagree (D)	2	3
Strongly Disagree (SD)	1	4

Based on the results of the score analysis above, calculate the interpretation of the score for each statement item using the following Eq. (2).

$$xi = \frac{\Sigma S}{Smax} \text{ x } 100\% \quad (2)$$

Description:
Xi : Score for each aspect
ΣS : Total Score
Smax : Maximum Score

The results of the total response percentage obtained will be interpreted in the criteria in Table 5.

Table 5. Response Questionnaire Score Interpretation Criteria

Score Percentage (%)	Score Category
81 – 100	Very Good
61 – 80	Good
41 – 60	Enough
21 – 40	Lacking
0 – 20	Very Lacking

(Kartini & Putra, 2020)

3. Result and Discussion

The result of this research is the development of interactive learning media on Google Sites-based on thermochemistry. The development of this learning media aims to outline how to create interactive learning media based on Google Sites and to evaluate its validity and student responses to the developed media. The process of developing interactive learning media based on Google Sites involves several key stages designed to create effective and engaging educational tools. Here are the steps in this process.

3.1. Analyze Stage

At this stage, the focus is on identifying the underlying causes of issues in learning, with the analysis summarized as follows.

3.1.1. Interview

According to the results of interviews with basic chemistry lecturers, it is stated that the Course Learning Outcomes (CLO) for thermochemistry include (M9) students being able to calculate the enthalpy of reaction, focusing on Hess' law, standard heat of formation, and bond energy. The learning process uses presentation methods and learning resources in the form of thermochemistry e-modules and Syukri's basic chemistry book published in 2010.

3.1.2. Needs Analysis

Based on the needs analysis conducted on second-year students on March 25, 2023, using Google Forms, it is known that the learning media used are in the form of whiteboards and e-modules. The writing is not neat, and the sitting position of students affects the readability of the writing on the blackboard. The use of e-modules is less interactive because it only displays writing, and students sometimes do not understand what is being presented. As many as 86.2% of students revealed that thermochemistry was difficult to understand. This is also in line with the results of the post-test of chemistry education students' class of 2022 on thermochemistry in basic chemistry courses having an average score of 55.3. In addition, as many as 80% of students want interactive learning media.

3.1.3. Making Storyboard

The result of the analysis process carried out is the creation of a storyboard containing the design of the media to be developed as a solution to the problems obtained. As a result, a concept for the learning media was developed, incorporating menus for objectives, material, games, glossary, creator, and reference.

3.2. Design Stage (Designing)

Based on the results of the previous analysis stage, the next step is to design a Google Sites-based thermochemistry interactive learning media according to the graduate learning outcomes to be achieved. In the design stage, the verification of desired outcomes and appropriate testing methods is performed by developing media designs, assembling supporting materials, and creating exercise questions.

Making media design using Canva, Photoshop, and PowerPoint applications. While making animated videos use additional Kinemaster applications to add the necessary back sound and narration. In addition, supporting materials for making thermochemistry are obtained from textbooks and online books through Google Books.

The creation of practice questions is placed in the "games" menu using the Wordwall and Quizizz application websites. According to Miftah and Lamasitudju (2022) note that the application of Qugamee using Wordwall enhances the quality of learning, making it more enjoyable and engaging. This approach can stimulate students' cognitive development, and students respond positively to its use in physics education. Additionally, Quizizz is an online learning tool that offers features for quizzes, surveys, games, and discussions. The Quizizz application presents learning material in the form of interactive questions across various themes and levels, with content created by educators themselves (Rahman et al., 2020).

3.3. Development Stage (Developing)

The development stage is the stage where what has been designed will be made in real form. At this stage, all the materials prepared at the design stage are collected into one to produce Google Sites-based thermochemistry interactive learning media.

3.3.1. Home Page

The search for icon elements and the creation of images have been made beforehand and applied as a background or media background. The color theme used is middle blue-green.

The main page contains several menus including Procedures & Objectives, Materials, Games, Glossary, References, and Creators. When students press the toolbar menu, the Procedures and Objectives page. The home page can be seen in Figure 2.

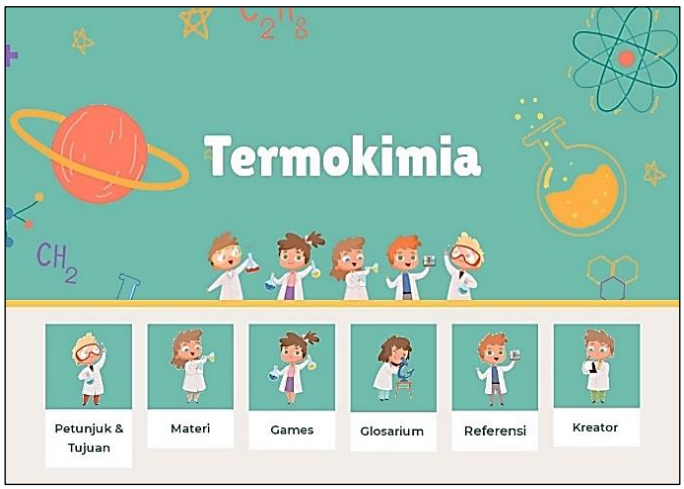


Figure 2. Home Page

3.3.2. Procedures & Objectives Page

This page displays the procedures for using Google Sites, learning outcomes, achievement indicators, and learning objectives. Steps that need to be taken to facilitate the use of Google Sites are also on this page. Course Learning Outcomes (CLO) have been adjusted to basic chemistry lecturers for thermochemistry. Learning objectives are outlined so that students know what the desired result is after studying thermochemistry from this Google Sites. This page features a "back" button to go to the main page and a "next" button to proceed to the material page.

3.3.3. Material Page

The material page contains learning materials that students will learn. The thermochemistry taken adjusts the M9 learning outcomes, which is students being able to calculate the enthalpy of the reaction. This page is equipped with material with details of understanding, system and environment, the enthalpy changes of reaction, Hess' law, standard heat of formation, bond energy, and animated videos which are divided into two parts.

The division of this animated video is done so that the duration between videos is not too long. The use of animation media has several advantages, including various elements such as moving images, text, sound, and videos that enrich the learning experience. Consequently, animation creates its attraction for students (Maulida et al., 2019).

Materials that require calculations are equipped with example problems whose discussions are made in the form of videos so that students know how to solve the problem. Practice problems are also given after students watch the video explanation. All videos are uploaded to YouTube for easy playback. According to Sari (2020), YouTube is a widely used video-sharing platform that enables users to access, watch, and share video clips for free.

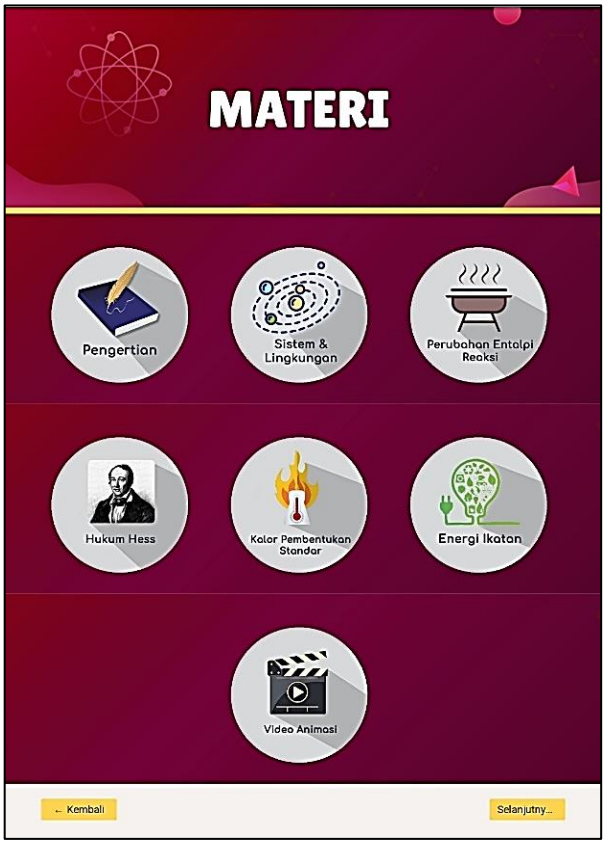


Figure 3. The Material Page

The material page features a back button to go to the main page and a next button to go to the games page. Each section of the material also features a back button to return to the next material and a next button to proceed to the next material. The material page can be seen in Figure 3.

The layout of the animated video page is illustrated in Figure 4. The first part of the animation video can be accessed on the YouTube link https://s.id/VidAniBagian1, while the second part can be accessed via the YouTube link https://s.id/VidAniBagian2.

3.3.4 Games Page

Google Sites-based thermochemistry interactive learning media in addition to containing material and animated videos for learning, this media also has games or games. The games made are also related to the learning material so that students can play while learning.

Games were created using Wordwall and Quizizz web applications. Find the match and match up are two types of games created using the Wordwall web application with question type C1 because if you use a more difficult and longer question type, the writing display on the mobile phone becomes small and invisible. As noted by Sahanata et al. (2022), the disadvantages of the Wordwall application include its susceptibility to cheating during use, as well as the limitation that the font size is fixed and cannot be adjusted, it takes a long time to design media or assessment tools.

The solution is to create a C4 question type using the Quizizz web application. This games page can also be an evaluation tool because the scores are automatically recapitulated at the end of the question. Quizizz offers advantages that make it useful for learning assessment, such as providing data and statistics on learner performance. These results can be utilized for follow-up evaluations of the learning process (Anggraini et al., 2020). The games page features a "back" button to return to the main page and a "next" button to proceed to the glossary page.

Figure 4. Animated Video

3.3.5. Glossary Page

This page contains important words and their definitions to make it easier for students to find the words they want to know.

The glossary page features a "back" button to return to the main page and a "next" button to proceed to the references.

3.3.6. References

This page contains various sources used in the preparation of thermochemistry learning materials ranging from textbooks or online books accessed through Google Books. The bibliography aims to show that a piece of writing or scholarship is not only based on the original thoughts of the author but also draws

on many references from the thoughts of many other people (Rahman & Jumino, 2020).

The reference page features a "back" button to return to the main page and a "next" button to proceed to the creator page.

3.3.7 Creator Page

The last page on this Google Sites media is the creator page. This page contains information about the author in the form of photos, names, and other personal information. This page includes a "back" button that allows users to return to the main page.

This interactive learning media based on Google Sites can be fully accessed through the Link:
https://s.id/MediaPembelajaranTermokimia

The next stage after the media is made is media validation to determine the validity of the media that has been made. The Google Sites media is assessed using a questionnaire crafted by the researcher. The developed media was evaluated by validators who specialize in both material and media.

Material validation was conducted by two material validators. The validation questionnaire consists of three sub-aspects including content, learning, and linguistics. The content sub-aspect contains seven indicator items, five learning indicator items, and six language indicator items which can be seen in Table 6.

Table 6. Results of Material Aspect Validation

Sub Aspect	No	Indicator	Description
Content	1	Appropriateness of concepts and definitions.	Relevant
	2	The suitability of the material with the Course Learning Outcomes (CLO)	Relevant
	3	Completeness of material and systematic order.	Relevant
	4	Ease of understanding the material.	Relevant
	5	Suitability of the video with the material.	Relevant
	6	Suitability of example questions with material.	Relevant
Learning Process	7	Suitability of games with material.	Relevant
	8	Easy to understand the questions in the games.	Relevant
	9	The suitability of the answer key.	Relevant
	10	Google Sites media supports independent learning.	Relevant
	11	Conformity with Indonesian language principle.	Relevant
Linguistics	12	Easy for understanding the used sentences	Relevant
	13	Sentences do not cause double meaning.	Relevant
	14	Simplicity and completeness of the information conveyed.	Relevant

Feedback and recommendations were given by the content validators concerning the media. The material validators provided input related to the reaction between ethene and hydrochloric acid in the animated video which was not correct. Then the amount of carbon in reaction equation number three and the amount of sodium in reaction equation number four in the material changes in the enthalpy of the reaction on the left and right are not the same. Games parts 1 and 2 need to be raised to C4 or analysis. In addition, input related to language is related to sentences ending with periods, there are still typos, capitalization in the middle of words, and words in and with at the beginning of sentences.

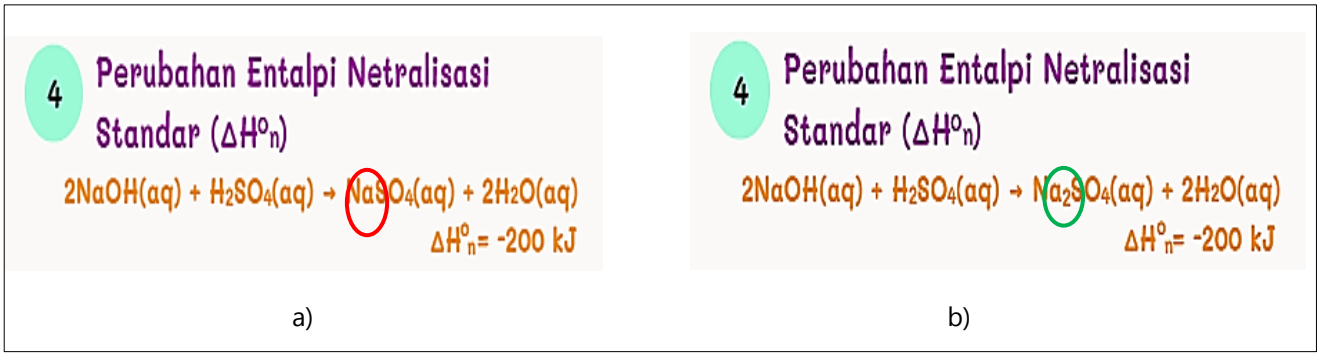


Figure 5. Revision of Reaction Equivalents

The following revisions were made in accordance with the validator's suggestions. Revisions made in Figure 5 are in part a) The reaction equation is not equivalent while in part b) The reaction is equivalent.

Revisions made in Figure 6 are in part a) The reaction equation is not yet equivalent and ΔH is empty while in part b) the reaction is equivalent and ΔH has been filled.

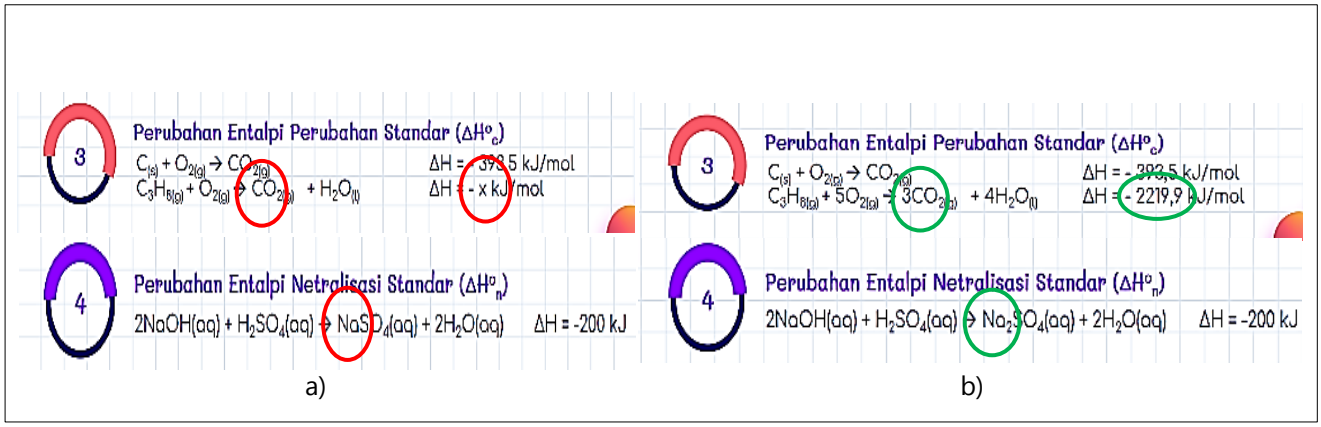


Figure 6. Revision of Reaction Equation

The revision given by the validator related to games part 1 and 2 needs to be raised to C4 or analysis cannot be implemented by the developer because if it contains a long question, the question display on mobile phone screen will look very small so it is difficult to read. Therefore, the developer provides more difficult questions in the 3rd game using Quizizz. The revision made in Figure 7 is the addition of a dot that was previously missing. The revisions made in Figure 8 are changes to the structure of ethene and chloroethane.

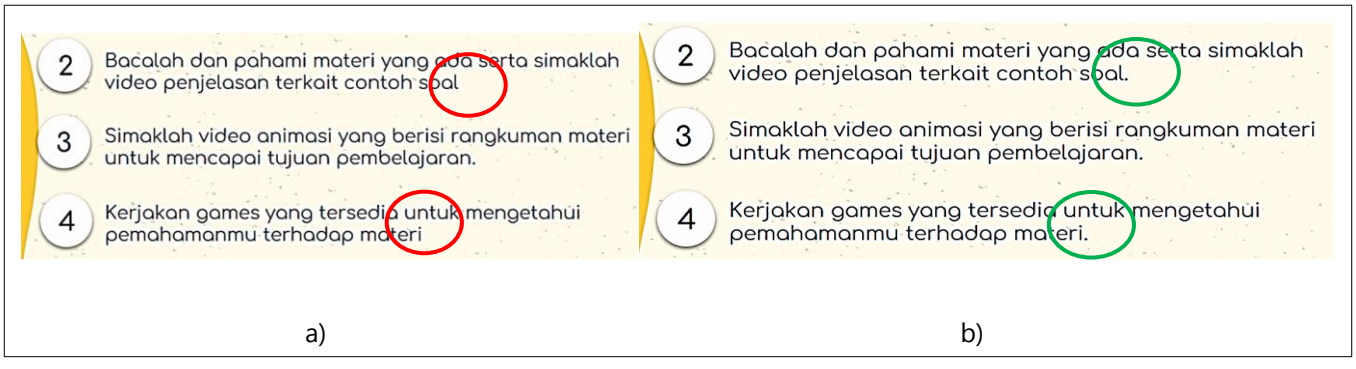
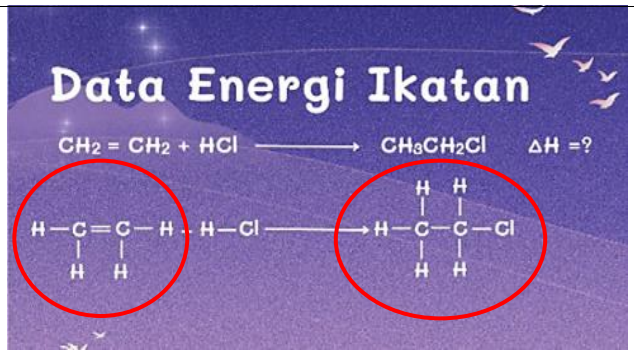


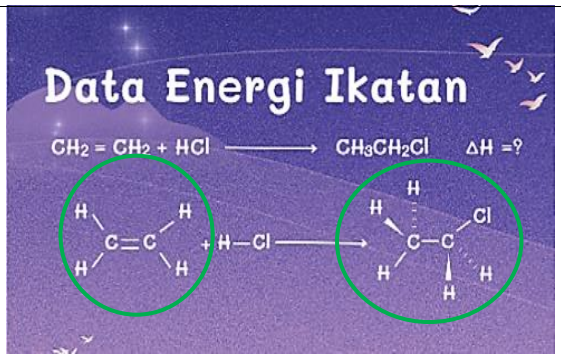
Figure 7. Revision of Punctuation

Media validation was carried out by two media validators. The validation questionnaire consists of two sub-aspects, which are visual communication and software engineering consisting of 18 indicators. The sub-aspects contain 14 visual communication indicators and four software engineering indicators which can be seen in Table 7.

There were no criticisms and suggestions given by the validators so that the conclusion was written as suitable for use without revision.



a)



b)

Figure 8. Revision Chemical Structure

Based on the explanation above, the results of the validation of Google Sites-based thermochemistry interactive learning media can be seen in Figure 9.

Table 7. Results of Media Aspect Validation

Sub Aspect	No	Indicator	Description
Visual Communication	1	Appropriateness of design to the material	Relevant
	2	The attractiveness of the media design.	Relevant
	3	Readability of the text.	Relevant
	4	Uniqueness of media selection.	Relevant
	5	Use of letter variations.	Relevant
	6	Color selection in the media.	Relevant
	7	Clarity of the images displayed.	Relevant
	8	The attractiveness of the game display.	Relevant
	9	The quality of the video displayed.	Relevant
	10	Color selection in the animation video.	Relevant
	11	The animation used is interesting.	Relevant
	12	The back sound was used.	Relevant
	13	Sound effects were used.	Relevant
	14	Narration in the animation video.	Relevant
Software Engineering	15	Maintainable (can be easily maintained or managed).	Relevant
	16	Usability (user-friendly and straightforward to operate).	Relevant
	17	Compatibility (the learning media can be installed and run on various available devices).	Relevant
	18	Reusable (some or all components of the learning media program can be utilized to create other learning media).	Relevant

The material aspect assessment relates to the quality of the material presented in the Google Sites media. The result of the validator's assessment of the material aspect is 0.94. These results indicate that in terms of the presentation of material in Google Sites-based thermochemistry interactive learning media fall into the category of very high. The

assessment is very high in the material aspect because the concepts presented in Google Sites are appropriate and complete from simple to complex which can help students achieve graduate learning outcomes.

The presentation of material in the animation video follows the concept of thermochemistry. The presentation of example problems and video solutions is in accordance with the concept and can assist students in grasping the concept of thermochemistry. Games presented are in accordance with the concept that can help students understand the concept of thermochemistry and do self-assessment. Google Sites learning media supports students to learn independently because it can be accessed anytime and anywhere.

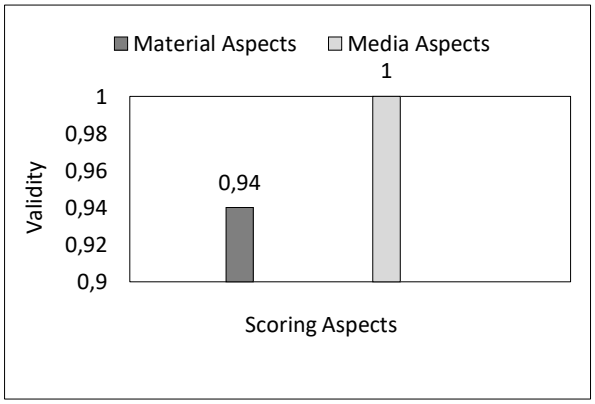


Figure 9. Recapitulation of Validation Results

The presentation of material in the animation video follows the concept of thermochemistry. The presentation of example problems and video solutions is in accordance with the concept and can assist students in grasping the concept of thermochemistry. Games presented are in accordance with the concept that can help students understand the concept of thermochemistry and do self-assessment. Google Sites learning media supports students to learn independently because it can be accessed anytime and anywhere.

The assessment of the media aspect pertains to the quality of Google Sites as a web-based interactive learning resource. The media validator's assessment of the Google Sites media obtained a score of 1.00. These results indicate that in terms of media included in the category very high. The assessment is very high in the media aspect because the quality of Google Sites media is very good from the visual communication and software engineering sub-aspects. The design of Google Sites is made in accordance with the material with good color selection so that it is visually appealing. The variety of letters used is not too much and the writing can be read well. The games presented are also visually appealing. The animation contained in the video is interesting and has good resolution. The use of sound effects in the video is appropriate and the background music used in the video does not interfere with the clarity of the narrative. Google Sites media can be used and managed easily, can be run on various existing devices, and can be reused to develop other learning media.

The next stage of validation is the response test on chemistry education students' class of 2022 to find out student responses to this Google Sites media. Details of the aspects consisting of 16 indicators can be seen in Table 8.

Based on data from Table 8, student responses to Google Sites-based thermochemistry interactive learning media are overall very good with a percentage of 83%. These results indicate that the material, animated videos, and games presented can help students understand the concept of thermochemistry. In accordance with research conducted by Rosita & Hardini (2022), learning websites with Google Sites helps to understand the material easily. The presence of animated video media can help students understand abstract material to be more concrete. In line with research conducted by Bahari, et al (2023), the presence of video displays and images on the media supports the material and can assist students grasp the material more easily. Furthermore, the inclusion of animated videos provides a new learning atmosphere for students to keep them engaged and ensure that students more easily understand the material (Dewi & Negara, 2021).

Table 8. Student Response Questionnaire Assessment Items (N=32)

Sub Aspect	No	Indicator	Description
Visual Communication	1	Ease of understanding the material.	Relevant
	2	Presentation of animated videos.	Relevant
	3	Presentation of Games.	Relevant
Learning Process	4	Independence of learning.	Relevant
Linguistics	5	Ease of understanding sentences.	Relevant
	6	Clarity of sentences used	Relevant
	7	The attractiveness of learning media design.	Relevant
	8	Letterforms used in learning media.	Relevant
Visual Communication	9	The size of the letters used in the learning media.	Relevant
	10	Color selection in the media.	Relevant
	11	The attractiveness of the animation video.	Relevant
	12	The back sound was used.	Relevant
	13	Clarity of narration in the video.	Relevant
Software Engineering	14	Ease of media use.	Relevant
	15	The flexibility of the media.	Relevant

Interactive learning media Google Sites-based on thermochemistry courses can facilitate independent learning. According to research by Salasa and Hasanudin (2023), the practical aspects of Google Sites allow students to access educational materials at any time and from anywhere, thus facilitating independent learning and better understanding. The learning media design of Google Sites and animated videos presented is visually appealing and easy to use anytime and anywhere without time limits. In line with research conducted by Nurlatifah and Suprihatiningrum (2023) Google Sites developed can be utilized as an alternative learning media to assist students in self-study, are easily accessible, and are flexible because they can be accessed using various devices and browsers. In addition, according to Kurniadi et al. (2021), Google Sites can be utilized from the side of lecturers and students at any time and can be accessed from the web or mobile.

Rosiyana (2021) stated that Google Sites allows for downloadable learning materials, enabling students to study from these resources anytime and anywhere. Google Sites can present material from the beginning to the end of the session, allowing students to revisit the content provided by the teacher, as the material is not lost automatically. In this fast-paced world, keeping up with the latest developments has become mandatory for professional education (Saxena et al., 2018).

Mulyaningsih et al (2023) said applying digital technology in education can provide more flexible and interactive learning. The flexibility to access and engage with learning resources caters to different learning styles and preferences, enhancing the effectiveness and enjoyment of the learning experience (Guinsisana, 2022). This active involvement also motivates students to take charge of their learning journey, fostering a more effective and rewarding educational experience (Noah & Gbemisola, 2020; Dhingra, 2021). The results of student responses to Google Sites media can be seen in Figure 10.

Made interactive based on multimedia can increase learning interest because it provides meaningful experiences through attractive displays and evaluation activities. Another theory states that student interest in learning can increase if the learning process uses Google Sites (Islamiah, 2021). The learning media design of Google Sites and animated videos presented is visually appealing and easy to use anytime and anywhere without time limits.

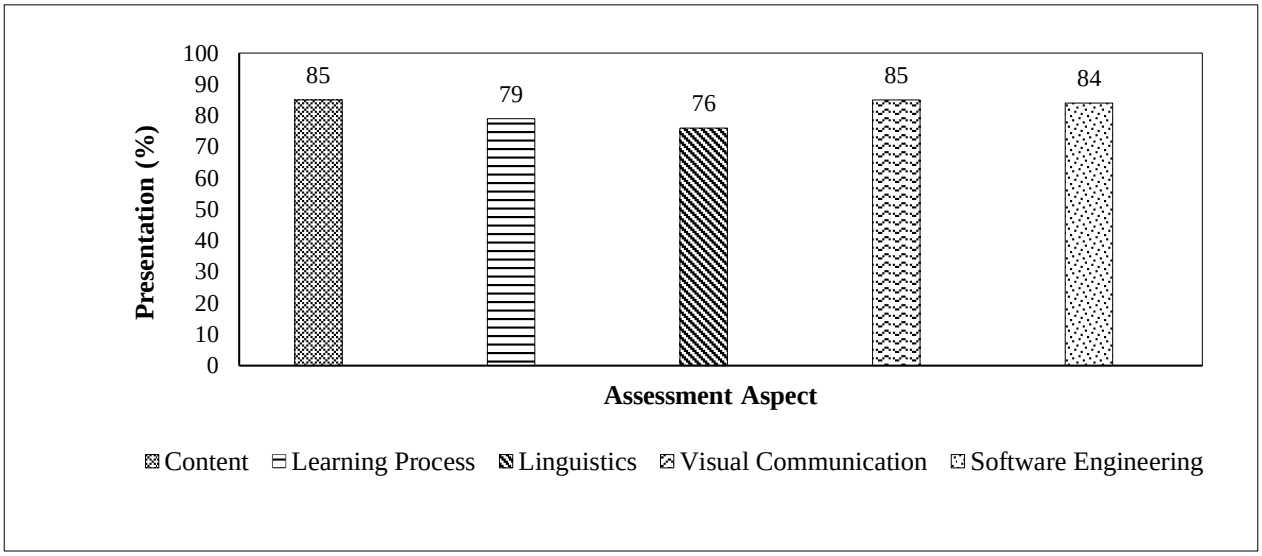


Figure 10. Student Response Questionnaire Results (N=32)

Overall, students gave very good responses to Google Sites-based thermochemistry interactive learning media. However, researchers found some shortcomings in the media based on student responses.

The software engineering aspect contains indicators of media ease of use and media flexibility. Six students disagreed and one student strongly disagreed with the ease of use of the media. In addition, two students answered disagree and one student strongly disagreed regarding media flexibility. This situation arises from the necessity for a strong and stable signal to access Google Sites media and view the displayed videos, resulting in some students experiencing difficulties in accessing the media and watching the videos. This weakness is in accordance with what was conveyed by Suharsono (2021), which is that Google Sites must be accessed online which depends on the internet network.

4. Conclusion

Interactive learning media Google Sites-based on thermochemistry courses has been approved and deemed feasible by material and media validators. The results of validation from material validators get a score of 0.94 which is classified as a "very high" category. Validation from media validators gets a score of 1.0 which is classified as a "very high" category. Response tests conducted on students get an average score of 83% with the category "very good". Based on this, it can be inferred that Interactive learning media on Google Sites-based on thermochemistry courses can enhance the teaching process of thermochemistry.

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