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THE USE OF GOOGLE SITES AS A LEARNING MEDIUM TO IMPROVE STUDENTS' COGNITIVE LEARNING OUTCOMES AND SELF-EFFICACY IN THE TOPIC OF BASIC LAWS OF CHEMISTRY

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Abstract

This study aims to determine the improvement in students' cognitive learning outcomes and self-efficacy through the use of Google Sites as a learning medium. The study was conducted at SMA Laboratorium UM in class X.4 in the 2024/2025 academic year with 36 students. The study was conducted using a Classroom Action Research (CAR) method. The instruments used were observation sheets, test questions, and self-efficacy questionnaires. The study results showed that the implementation of learning in cycle I was 88.28% and in cycle II was 90.50%. In addition, students' cognitive learning outcomes increased, as evidenced by the students' classical completeness rate, which rose from 44.44% in cycle I to 88.89% in cycle II. Students' self-efficacy also increased from 24.50 to 30.14 in cycle II and was categorised as high. Thus, the use of Google Sites as a learning medium has been shown to improve students' cognitive learning outcomes and self-efficacy in the context of the Basic Laws of Chemistry material.
Key words: google sites, class action research, cognitive learning outcomes, self-efficacy.

INTRODUCTION

Technology has advanced rapidly in the 21st century, bringing major changes, especially in education. These developments have made technology a central part of daily life. This is especially true for younger people, who regularly use devices like cell phones, laptops, and tablets in their everyday activities. The use of technology in the learning process not only helps teachers to make learning interesting and enjoyable but also helps students to develop the knowledge and skills needed in the 21st century (1). Solikhin (2021) states that the use of technology as a tool and device in learning needs to be applied more deeply so that it can have a positive impact on students (2). The way to achieve this is by maximizing the role of innovative and interactive learning media (3).

Chemistry has been considered a challenging subject for students because most chemical concepts are abstract, involve numerous complex terms, and require advanced mathematical skills (4). Based on observations conducted in class X.4 at the SMA Laboratorium UM, many students struggled to understand the material on the Basic Laws of Chemistry. They were unsure about how to solve the problems given. The low level of student understanding may stem from several factors. One reason is the lack of learning media that can present material in an engaging, interactive, and contextual way. Another concern is low self-efficacy, which means a person does not believe in their ability to understand and complete academic tasks. This can create barriers to learning. Bandura (2013) said that self-efficacy is the belief in one's ability to take the necessary steps to succeed (5). Research has shown that students' cognitive learning outcomes are significantly influenced by their level of self-efficacy, particularly when learning science (6). Self-efficacy has been shown to significantly predict

students' academic achievement in the context of learning chemistry. Higher self-efficacy among chemistry students is associated with a greater likelihood of utilizing meaningful learning strategies and achieving better academic outcomes (7).

Rahmawati (2024) found that both self-efficacy and learning independence, when considered individually and in conjunction, significantly and favorably impacted students' learning achievement in chemistry (8). Furthermore, reviews indicate that learning outcomes are consistently predicted by chemistry self-efficacy more strongly than by related constructs, such as self-concept (9). The cause of low self-efficacy in students during the problem-solving process is that they do not fully understand the concepts, which prevents them from analyzing the important information needed to solve problems (10). Therefore, innovative learning media are required to improve cognitive learning outcomes by fostering greater self-efficacy, in addition to making it easier for students to understand abstract chemistry concepts.

Web-based learning media, such as Google Sites, are one of the innovative and interactive learning media. Google Sites enables the structured and flexible arrangement of learning materials, allowing students to access them at any time and from anywhere according to their needs. Google Sites-based learning media can be accessed through various devices, such as mobile phones, tablets, and laptops. Google Sites can also be converted into an Android-based web application, allowing it to be easily accessed using a mobile phone (11). Google Sites allows teachers to present material in different formats, such as videos, text, interactive quizzes, and discussion forums (12).

According to Waryana's (2021) research, the use of Google Sites in learning can increase students' learning independence and facilitate understanding of the material through rich multimedia content (13). In the chemistry subject, Google Sites can include multimedia-based content such as animated videos of Basic Laws of Chemistry, interactive quizzes to test students' comprehension, downloadable worksheets and materials, virtual laboratory, games for ice breaking, and discussion features like Padlet. Google Sites' design aimed to make abstract Basic Laws of Chemistry more tangible, while also encouraging independent learning and reflection. The use of visual and interactive elements helped bridge the gap between symbolic representations and real-world applications of Basic Laws of Chemistry.

Recent studies provide strong evidence on the application of Google Sites, specifically for teaching the Basic Laws of Chemistry. Pratiwi (2025) reported the development of Google Sites-based media for learning the Basic Laws of Chemistry, validation by media and chemistry experts scored 94-95% (categorized as "very good"), and student responses reached 100% positive acceptance, demonstrating the efficacy of Google Sites in illustrating complex chemical concepts (14). Similarly, Qurrota (2024) developed Google Sites for the same topic gaining high media validity results and positive feedback from teachers and students (15).

Based on the advantages of Google Sites as an innovative and interactive learning medium, further research is needed to analyze its use in chemistry learning, particularly in the subject of Basic Laws of Chemistry. Therefore, this study aims to analyze the use of Google Sites as a learning medium for students in class X.4 at the SMA Laboratorium UM in the subject of Basic Laws of Chemistry, particularly in terms of self-efficacy and cognitive learning outcomes.

METHOD

This study was conducted using the Classroom Action Research (CAR) with a mixed-methods approach for data analysis. Quantitative data were collected through cognitive learning outcome tests and self-efficacy questionnaires, while qualitative data were obtained from observations of learning implementation. CAR was carried out by referring to the Kemmis and McTaggart model, which consists of four stages: planning, action, observation, and reflection (16). The CAR cycle used in this study is illustrated in Figure 1. During the planning stage,

the researcher conducted direct observations of the conditions and characteristics of students in class X.4 at the SMA Laboratorium UM in Malang City for the 2024/2025 academic year. Additionally, the researcher conducted informal interviews with chemistry teachers and students and prepared a self-efficacy questionnaire for students. After identifying issues in the classroom, the researcher implemented the action stage to address these issues, including selecting teaching models and approaches, developing instructional modules, and preparing innovative learning media. During the action stage, Google Sites was implemented as an innovative learning medium for students. Subsequently, the researcher observed the implementation of learning with the assistance of fellow teachers, measured self-efficacy, and assessed students' cognitive learning outcomes. During the reflection stage, the researcher identified the obstacles encountered in the previous learning process and improved them in the next cycle. The learning cycle will end if the results are in line with the researcher's expectations, namely that the application of Google Sites media can improve students' self-efficacy and cognitive learning outcomes, as shown by the data from the self-efficacy questionnaire and learning test results.

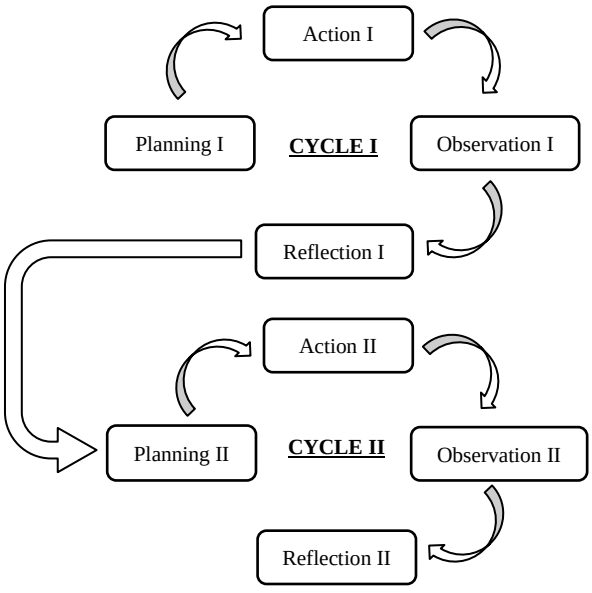

Figure 1. Class Action Research (CAR) Cycle (16)

The research subjects were 36 students in class X.4 of the SMA Laboratorium UM for the 2024/2025 academic year, while the research objects were students' self-efficacy and cognitive learning outcomes on the subject of Basic Laws of Chemistry. In this study, purposive sampling was used, so the selected sample was the result of the researcher's consideration. The instruments used for data collection included a self-efficacy questionnaire, a cognitive learning achievement instrument, and an observation sheet on the implementation of learning. Students' cognitive learning achievements were measured through post-test results administered at the end of the cycle. The measurement tool used to assess students' cognitive learning outcomes is an essay question developed by Apriani (2023), with a reliability value of 0.717 and has undergone validity testing by the original author. Therefore, these questions are considered valid and appropriate for measuring students' cognitive learning outcomes (17). The students' cognitive learning outcomes data were analyzed descriptively and quantitatively and converted using the criteria in Table 1. The indicator used for students' cognitive learning outcomes is the KKM score, based on the school's decision at SMA Laboratorium UM, where students are considered to have reached mastery if their quiz score is at least 75 (good criteria). In addition, this class action research will be completed if the percentage of students' classical mastery in the class reaches 75%.

Table 1. Interpretation of Values (18)

Value Interval (%)	Criteria
0-20	Very poor
21-40	Poor
41-60	Fair
61-80	Good
81-100	Very good

The self-efficacy questionnaire was adopted from the General Self-Efficacy (GSE) questionnaire developed by Ralf Schwarzer and Matthias Jerusalem (19). The GSE aims to measure self-efficacy in a broad or generalized context, rather than focusing on a specific task or situation. This GSE questionnaire has been translated into Indonesian with a reliability value of 0.722 (20). The questionnaire consists of 10 items and was

administered at the pre-cycle, end of cycle I, and end of cycle II. The GSE item list can be seen in Table 2. Students' self-efficacy scores were interpreted into three categories: low (<20), moderate (20–30), and high (>30) (21). Supporting data were obtained from observations of the implementation of learning activities.

Table 2. GSE Items

No	Item
1	I can always manage to solve difficult problems if I try hard enough.
2	If someone opposes me, I can find the means and ways to get what I want.
3	It is easy for me to stick to my aims and accomplish my goals.
4	I am confident that I could deal efficiently with unexpected events.
5	Thanks to my resourcefulness, I know how to handle unforeseen situations.
6	I can solve most problems if I invest the necessary effort.
7	I can remain calm when facing difficulties because I can rely on my coping abilities.
8	When I am confronted with a problem, I can usually find several solutions.
9	If I am in trouble, I can usually think of a solution.
10	I can usually handle whatever comes my way.

RESULTS AND DISCUSSION

This study took place over three cycles: the pre-cycle, cycle I, and cycle II. Each cycle included two to three meetings. In the pre-cycle, the researcher made initial observations of students' self-efficacy and cognitive learning outcomes before starting classroom interventions. Based on the results of the pre-cycle observations, the researcher decided on appropriate classroom interventions to address the issues and implemented them during cycles I and II of the learning process. The discussion in this study focuses on the implementation of learning, cognitive learning outcomes, and self-efficacy of students in class X.4 of SMA Laboratorium UM.

Learning Implementation

The level of learning implementation in cycle I and cycle II is shown in Figure 2. Based on the data in the figure, the learning process is considered to have run well. This is evidenced by the learning implementation reaching 88.28% in cycle I and increasing to 90.50% in cycle II, both of which have exceeded the learning implementation target of 85%. This percentage indicates that the learning steps designed by the teacher can be followed well by students. However, there are still shortcomings in some stages of learning, particularly in the closing section, where reflection activities are often not carried out due to time constraints. Additionally, the use of learning media in the first meeting was less than optimal because the learning activities carried out were laboratory practicals. Although the learning implementation percentage was not perfect, these results indicate that the teachers had designed the learning process well and were able to conduct teaching activities in the classroom effectively. A well-designed learning process will have a positive impact on students' academic performance (22).

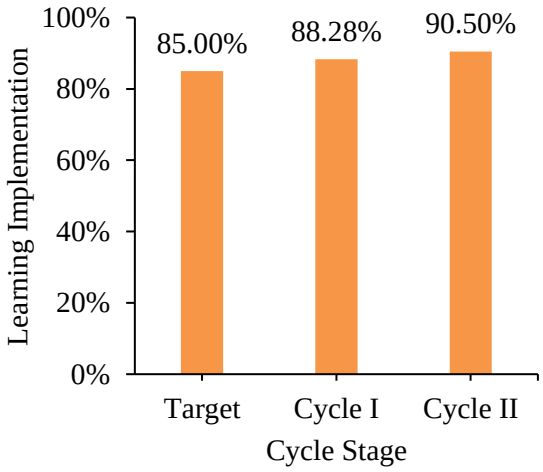

Figure 2. Learning Implementation in Cycles I and II

Cognitive Learning Outcomes

Cognitive learning outcomes were obtained from quiz scores administered during the final meeting of each stage: the pre-cycle, cycle I, and cycle II. These scores were then compared to determine the improvement in students' cognitive learning outcomes after using Google Sites as a learning medium. Data on cognitive learning

outcomes during the pre-cycle, cycle I, and cycle II stages are presented in Table 3.

In the pre-cycle stage, the teacher still used conventional learning media, namely PowerPoint presentations and handouts for students. Based on Table 3, the use of Google Sites in teaching the subject of Basic Chemistry can improve students' cognitive learning outcomes. The average quiz score increased from 53.99 in the pre-cycle to 89.14 in cycle II. Classical mastery also showed an increase, from 27.78% in the pre-cycle, 44.44% in cycle I, and reaching 88.89% in cycle II. The classical mastery achieved in cycle II has exceeded the mastery target of 75%. These results are consistent with research conducted by Johdi (2024), which showed an increase in the average pre-test and post-test scores from 38.80 to 84.71 after using Google Sites as a learning medium (23). Syah (2025) also stated that the use of Google Sites as a learning medium has been proven to improve students' cognitive learning outcomes, with an average increase in student scores of 74.88% (24).

Based on the observations and field notes conducted by the researcher and observer, there are several factors that caused the classical mastery not to be achieved in cycle I, including: (1) the initial perception among students that the Chemistry subject is difficult to understand, (2) students still face difficulties in performing the mathematical operations required to solve problems, (3) a lack of confidence among students when working on practice problems, (4) some students did not print the Student Worksheets (LKPD) available on Google Sites, so the learning process did not run optimally, (5) although students actively accessed and studied the material on Google Sites, they still had difficulty when working on questions that were different from the examples, and (6) some students did not yet understand how to access and navigate the Google Sites learning media optimally.

Table 3. Comparison of Cognitive Learning Outcomes

Indicator	**Pre-Cycle**	**Cycle I**	**Cycle II**
Average quiz score	53.99	63.14	89.14
Target (%)	75.00	75.00	75.00
Classical mastery (%)	27.78	44.44	88.89
Criteria	Did not meet target	Did not meet target	Met target

Based on the reflection conducted in cycle I, the improvement actions taken by the researcher in cycle II were (1) simplifying the explanation of the material and relating it to everyday life contexts, (2) providing more structured practice questions with guidance in solving them, (3) motivating students that the questions are not as difficult as imagined and always giving praise when students successfully solve the questions, (4) providing printed worksheets for students who forgot to bring them, and (5) giving clear instructions on the link and how to use Google Sites before the lesson began. In cycle II, students appeared more active and enthusiastic in accessing Google Sites as a learning medium. Students also appeared more confident in practicing questions and more willing to ask teachers when they encountered difficulties. Based on the achievement of classical mastery that met the target, the researcher decided not to proceed to the next cycle.

Self-Efficacy

The assessment of students' self-efficacy was conducted based on data from questionnaires completed by each student in class X.4 at the pre-cycle stage, the end of cycle I, and the end of cycle II. The self-efficacy scores can be seen in Table 4. Based on Table 4, students' self-efficacy increased significantly from the pre-cycle to cycle II. In the pre-cycle stage, the average self-efficacy score of students was 20.14, then increased to 24.50 at the end of cycle I and fell into the moderate category. At the end of cycle II, the average self-efficacy score of students increased again, reaching 30.14 and falling into the high category.

Table 4. Overall GSE Score and Category

Stage	Average Score	Category
Pre-cycle	20.14	Moderate
Cycle I	24.50	Moderate
Cycle II	30.14	High

To view more details on the self-efficacy data, Table 5 below presents the average score for each GSE item in each cycle, where the GSE score ranges from 1 (strongly disagree) to 4 (strongly agree). Based on the data, all items showed an increase in mean scores from pre-cycle to cycle II. For example, Item 4 (“Saya yakin bahwa saya dapat bertindak dengan baik dalam situasi yang tidak terduga”) increased from 1.86 to 3.36, indicating an increase in students' confidence in handling uncertainty. Meanwhile, item 10 (“Apapun yang terjadi, saya akan dapat mengatasinya dengan baik”) may require further attention, as it had the smallest average score in Cycle II. Overall, the increase in the mean score of each item reflects a general increase in students' perceived self-efficacy after the intervention.

Table 5. GSE Score per Item

Item	Average Score		
	Pre-Cycle	Cycle I	Cycle 2
1	1.89	2.56	2.92
2	2.22	2.39	3.08
3	1.97	2.47	3.11
4	1.86	2.39	3.36
5	1.97	2.28	2.86
6	1.83	2.11	2.94
7	1.94	2.50	2.97
8	1.97	2.67	3.14
9	2.33	2.64	3.03
10	2.14	2.50	2.72

Table 6 shows that 66.70% of students were in the low self-efficacy category and 33.30% were in the moderate category in the pre-cycle stage. This suggests that most students felt uncertain about their ability to solve various chemistry problems. Next, the treatment was applied in the form of using Google Sites as an innovative learning medium. At the end of cycle I, the low self-efficacy category decreased to 19.40% of students. In comparison, 72.20% of students fell into the moderate self-efficacy category, and 8.30% of students fell into the high self-efficacy category. At the end of cycle II, no students were in the low self-efficacy category, 41.70% of students were in the moderate self-efficacy category, and 58.30% of students were in the high self-efficacy category. The significant increase in the percentage of students in the high self-efficacy category at the end of cycle II can be used as evidence that the use of Google Sites as a learning medium can indeed increase students' self-efficacy. These results are consistent with research conducted by A'yuni (2024), which shows that the use of Google Sites as a learning medium can increase students' self-efficacy, with an average increase of 75.40% (25).

Table 6. Number of Students by Self-Efficacy Category

Stage	Category		
	Low	Moderate	High
Pre-cyle	24 students (66.70%)	12 students (33.30%)	0 student (0.00%)
Cycle I	7 students (19.40%)	26 students (72.20%)	3 students (8.30%)
Cycle II	0 student (0.00%)	15 students (41.70%)	21 students (58.30%)

Based on the reflection results from cycle I, several actions that need to be taken in cycle II to further enhance students' self-efficacy include providing more opportunities for students to present or write their answers in front of the class, awarding points integrated with the school's code of conduct as a form of appreciation for students' active participation in class, continuing to provide appreciation in the form of points/applause/praise that can motivate students even if their answers are not entirely accurate, increasing personal approaches to better understand the challenges students face, providing additional motivation regarding the importance of the material being studied, teaching structured steps in answering questions, and explaining the material in simpler language to make it easier for students to understand. In cycle II, the average self-efficacy score of Class X.4 students had reached the target, i.e., the high category (>30), so the researcher decided not to proceed to the next cycle.

The study's results show a positive relationship between self-efficacy and students'

cognitive learning outcomes. In cycle II, there was a significant increase in self-efficacy, as well as in cognitive learning outcomes. The results are supported by previous research. Villafañe (2016) found a positive relationship between chemistry self-efficacy and students' cognitive learning outcomes (7). Ramnarain (2018) also found a significant relationship between self-efficacy and cognitive learning outcomes of students across various areas of study (9). However, it must be acknowledged that several extrinsic variables also influence learning outcomes, such as student motivation. Alafgani (2019) state in their research that academic motivation and self-regulated learning have a combined influence on cognitive learning outcomes (26). Moreover, Meng (2023) also said that alongside self-efficacy, academic engagement plays a significant role in shaping learning outcomes by serving as a mediating factor that connects self-belief with achievement (27).

CONCLUSION

The use of Google Sites as a learning medium over two cycles of classroom action research resulted in a classical achievement rate of 44.44% in cycle I, which increased to 88.89% in cycle II. Students' self-efficacy also improved from 24.50 to 30.14 in cycle II and entered the high category. Additionally, the implementation of learning also showed high values in cycles I and II, with 88.28% in cycle I and 90.50% in cycle II. Overall, this study demonstrates that the use of Google Sites as a learning medium can enhance students' cognitive learning outcomes and self-efficacy.

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