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Development of G-Sites that Support Students' Self-Regulated Learning Using TGT Type of Cooperative Learning

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Abstract

Independence in learning can be built through self-regulated learning. The low of student self-regulated learning occurred in students of class X.1 State Senor High School (SMAN) 6 Malang. So far, research related to improving students' self-regulated learning has only focused on strategies without supporting learning media. Therefore, it is necessary to conduct a research and development study on instructional media that can enhance students' self-regulated learning. The purpose of this study is to develop a G-Sites-based learning media integrated with the TGT type of cooperative learning model to improve students' self-regulated learning. This study employs the ADDIE development model, which consists of the stages of analysis, design, development, implementation, and evaluation, carried out systematically. The sampling technique used in this study is purposive sampling, as the research is based on a problem related to low self-regulated learning identified in class X.1. The subjects of this research were students of class X.1, students of class XI as respondents of readability test, and chemistry teachers of SMAN 6 Malang as validators of material and media experts. Data analysis was carried out using a mixed-method approach, both qualitative and quantitative, employing descriptive and percentage analysis techniques. The developed product was declared valid and feasible to use with percentage results on the graphic design aspect of 83%; presentation and use of media 80%; suitability of material 97%; presentation of material 93%; language 88%; suitability of syntax 97%; and suitability of self-regulated learning 100%. The implementation of G-Sites is proven to increase students' self-regulated learning by 14.5%.

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INTRODUCTION

The low self-regulated learning can be shown by the inability of individuals to complete tasks optimally. This can be caused by the lack of students' ability to respond to various stimuli given during the learning process which ultimately affects proper decision making (Bayantari et al., 2022). Based on the results of observations on chemistry learning conducted on students in class X.1 of State Senior High School (SMAN) 6 Malang, student behavior during learning shows low self-regulated learning. The behaviors in question include; joking with friends, playing gadgets when the teacher is explaining, and not actively interacting in discussions. This was validated through a self-regulated learning questionnaire which showed that 69% of the total students indicated an inability to self-regulate which had an impact on the inability to complete tasks optimally in chemistry learning.

Zimmerman's (1990) foundational work defines self-regulated learning (SRL) as a multidimensional construct encompassing: autonomous learning strategy implementation, adaptive responsiveness to learning effectiveness, and sustained self-motivation processes. This conceptual framework was later expanded (Zimmerman, 2002) to incorporate three cyclical phases: forethought (planning), performance (execution), and self-reflection (evaluation), a process particularly crucial for overcoming academic distractions and maintaining focus. The empirical significance of SRL is well-established, with Ergen and Kanadli's (2017) research demonstrating its substantial predictive power for academic achievement ($R^2 = 0.859$).

Contemporary meta-analytic work by Zheng et al. (2024), examining literature from 2009-2020, has further established significant correlations between SRL development and game-based learning methodologies. Particularly relevant is their finding that the Teams-Games-Tournament (TGT) approach as a cooperative game-based learning inherently cultivates SRL through its requirement for goal-oriented behavior, peer-mediated learning, and continuous self-monitoring during instructional activities. Based on the findings, the TGT cooperative learning model may offer a suitable strategy for improving students' self-regulated learning, aligning with the challenges observed in Grade X.1 of SMAN 6 Malang. In TGT, students are grouped heterogeneously in terms of ability, gender, and ethnicity or race. According to Slavin (1988), there are 5 learning stages in TGT, namely class presentation, learning in groups, games, tournament, and team recognition.

Beyond teaching methods, instructional media play an equally important role in enhancing learning quality. The chemistry learning in Class X.1 at SMAN 6 Malang utilizes a comprehensive range of teaching materials and learning media, including textbooks, student worksheets (LKS), modules, handouts, digital presentations, and educational games. These resources are delivered through varied instructional approaches such as classroom discussions, question-and-answer sessions, lectures, and practical laboratory work. An initial analysis of this learning environment revealed that 92% of students found electronic-based learning media particularly suitable for chemistry education.

G-Sites serves as an effective alternative learning medium to enhance students' self-regulated learning (SRL) due to its user-friendly development and modification features. *G-Sites* as one of the platforms provided by Google has several website builder features that can be utilized without having to use programming languages. Learning websites developed through *G-Sites* can display text, images, audio, video, animation, and links (Aulia et al., 2021). *G-Sites* as a platform for developing web-based learning media has the advantages of being easy to create, does not require costs, can be used and developed collaboratively, and can be searched through search engines easily (Islanda & Darmawan, 2023). Research conducted by Sitepu & Herlinawati (2022) shows that *G-Sites* web-based learning media on chemical bonding material that has been declared valid and feasible can contain information about learning objectives, material, learning videos, Quizzes, discussion rooms, and task collection packaged in one learning media.

G-Sites-based learning media can also be developed using certain learning models, such as case-based learning which can improve critical thinking skills (Gesy et al., 2022); project-based learning which can improve student collaboration skills (Sari & Rochmiyati, 2023); and discovery learning which can improve the quality of student learning (Mustofa et al., 2024). A review of existing literature reveals that the development of Google Sites-based instructional media incorporating the TGT cooperative learning model to enhance self-regulated learning remains unexplored.

Based on the analysis of students' low self-regulated learning (SRL) and the need for technology-based learning media in Class X-1 at SMAN 6 Malang for chemistry subjects, the

researcher found that the low SRL may be caused by the lack of appropriate learning strategies and media to support students' SRL. Therefore, the researcher proposes the Teams-Games-Tournament (TGT) cooperative learning model and G-Sites as alternative solutions to address these issues in Class X-1. The TGT model has been proven to enhance SRL through its goal-oriented approach that aligns with Zimmerman's SRL framework (Zheng et al., 2024). Meanwhile, G-Sites as a web-based learning platform can promote students' learning independence through teacher-designed activities in a single and easily accessible platform (Salsabila & Aslam, 2022).

No previous studies have developed G-Sites integrated with the TGT cooperative learning model to improve SRL. Thus, the researcher considers it necessary to develop a G-Sites-based learning media integrated with the TGT model to enhance SRL, which becomes the main objective of this study to solve the low SRL problem in Class X-1. The G-Sites learning will be designed to explicitly incorporate Zimmerman's SRL framework stages with various learning activities and resources accessible in one platform.

METHODS

This study used a research and development (R&D) design. Through this research, products are produced that have been tested for feasibility and tested to be implemented (Sugiono, 2016). The products produced from this research are learning media in the form of *G-Sites* that use the TGT type of cooperative learning model. This learning media is also enriched with activities that support the development of students' self-regulated learning. This learning media was developed on stoichiometry material. Through this development, it is expected to produce *G-Sites* learning media that can encourage students' self-regulated learning.

The development research design used refers to the ADDIE instructional design model (Branch, 2010). This instructional design includes the stages of analyze, design, development, implementation, and evaluation with the evaluation stage carried out dynamically in each stage. With the evaluation at each stage of development, this instructional design can minimize the shortcomings and errors of the developed product (Waruwu, 2024). This instructional design is commonly used in the development of performance-based learning products (Mariam & Nam, 2019).

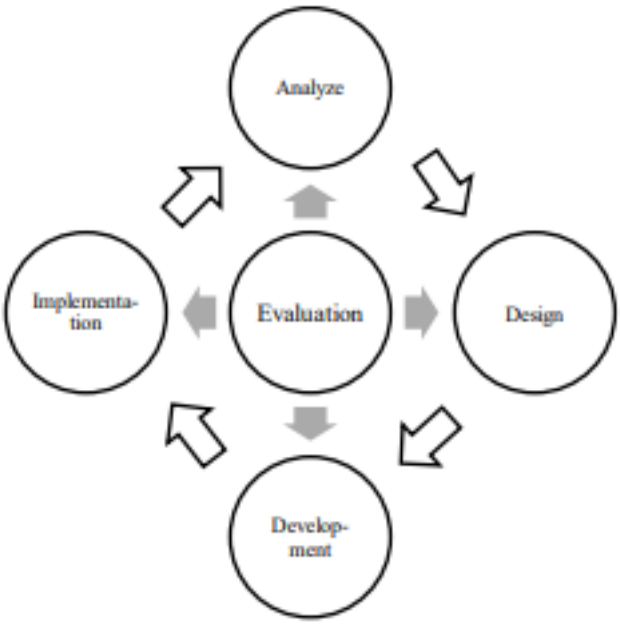

Figure 1. The stages of the ADDIE development model (Waruwu, 2024)

At the analysis stage, problem identification and analysis of the need for product development are carried out (Waruwu, 2024). The aspects analyzed include; needs analysis, audience, problems, technology, and others (Lee & Owens, 2004). At the design stage, a conceptual design is carried out which becomes a reference for the next stage. At the development stage, the product that has been planned at the previous stage is developed and then tested. At this stage, instruments are also developed to test the validity and feasibility of the products developed. At the implementation stage, the products that have been tested are applied to the target audience that has been determined at the beginning of the development research stage. At this stage, the research target provides feedback on the product that has been developed. At the evaluation stage, improvements are made to the developed product by considering the feedback received at each stage of the development research. In addition, at this stage, measurements are also made of the achievement of the objectives of the development research that has been carried out (Waruwu, 2024). The entire stages in this development research was carried out from February 21 to May 9 2025.

The sampling technique used in this study is purposive sampling, as the research is based on a problem related to low self-regulated learning identified in class X.1. This development research employed multiple participant groups from SMAN 6 Malang, including 31 class X.1 students as primary subjects for product implementation, along with 24 Class XI students who had completed stoichiometry material as readability test respondents, and two chemistry teachers as expert validators for both media and content evaluation.

The study utilized questionnaire-based instruments, including validation test questionnaires, readability assessments, and self-regulated learning questionnaires, to collect both qualitative and quantitative data. Qualitative feedback from validators and readability test participants was analyzed descriptively to examine critiques, suggestions, and comments, while quantitative data from validation and readability assessments were analyzed statistically to determine the product's validity and comprehensibility. This mixed-methods approach enabled a thorough evaluation of the educational product's effectiveness and usability in supporting students' self-regulated learning in chemistry.The quantitative data processing uses a percentage formula that refers to Optiana & Muchlas (2019) as follows:

$$NP = \frac{R}{SM} \times 100\%$$

Description:
NP = Percent value
R = Score obtained
SM = Maximum score

Based on the percentage value obtained, it can be concluded that the feasibility category of the product developed from the validity test is based on the following Table 1

Table 1. Criteria for feasibility of product development

Percent value (%)	Category	Description
76-100	Very Feasible	Valid (no revision needed)
56-75	Feasible	Fairly Valid (no revision needed)
40-55	Less Feasible	Less Valid (revision needed)
0-39	Not Feasible	Not Valid (revision needed)

(Sumber : Optiana & Muchlas, 2019)

In addition, the percentage value obtained can be concluded in the category of product readability by students according to Table 2 below

Table 2. Readability Test Criteria

Percentage Value (%)	Category
81-100	Very good
61-80	Good
41-60	Medium
21-40	Not good
0-20	Not very good

(Adapted from Sarip et al., 2022)

The data obtained through the self-regulated learning questionnaire is quantitative data which is analyzed using descriptive analysis techniques to describe students' self-regulated learning ability. The mean value of students' self-regulated learning was then categorized based on Table 3 below.

Table 3. Criteria for Self-Regulated Learning Ability

Average Value	Category
1,00 – 1,74	Not very good
1,75 – 2,49	Not good
2,50 – 3,24	Good enough
3,24 – 4,00	Good

(Adapted from Wahdah & Rahman, 2023).

The developed learning media was implemented using a pre-experimental design to examine potential improvements in students' self-regulated learning (SRL) abilities following instruction with the *G-Sites* platform integrated with the Teams-Games-Tournament (TGT) cooperative learning model. To quantitatively assess these improvements, researchers employed an N-Gain analysis. Prior to conducting the N-Gain test, a prerequisite T-test was performed to verify the independence of pre-test and post-test scores from the SRL questionnaire, ensuring the data met necessary assumptions for analysis. This preliminary analysis confirmed that the pre- and post-treatment scores were not correlated and followed a normal distribution, meeting the parametric test requirements, providing a normalized measure of learning improvement that accounts for initial knowledge levels while allowing for meaningful comparison across different starting points. This methodological approach enabled rigorous evaluation of the intervention's in enhancing students' self-regulated learning capabilities.

The results of this quantitative test were then enriched through the results of observations made by the observers, namely the chemistry teachers and two PPG Calon Guru students. This was done to support qualitative data by describing the situation during learning using the *G-Sites* that had been developed. The interpretation of the N-Gain test results is as follows

Table 4. Category of self-regulated learning improvement based on N-Gain test

$\overline{N-Gain}$	Category
g < 0,3	Low
0,3 < g < 0,7	Medium
g > 0,7	High

RESULTS AND DISCUSSION

Analyze Stage

In the analysis stage, the problems experienced by the research target, in this case the students of class X.1 SMAN 6 Malang, were identified. Based on the results of observations during

chemistry learning in class X.1, the observers through the lesson study found several problems experienced by students, one of which was the inability to complete optimally. The following are several excerpts from the learning observations conducted by chemistry teachers and two PPG Calon Guru Program students.

"… Beberapa siswa agak sulit mengikuti karena mengantuk (Some students found it difficult to stay focused because they were sleepy)*."* (Chemistry Teacher).

"Beberapa siswa yang tidak dapat belajar dengan baik, kemungkinan disebabkan karena siswa kurang antusias dengan pembelajaran, sehingga selama pembelajaran berlangsung mereka asik dengan kegiatannya sendiri, meletakkan kepalanya ke bangku, tidur, bercanda dengan teman sebangkunya, dan mengoperasikan HP, sehingga tidak memperhatikan penjelasan dari guru dan mengikuti pembelajaran dengan baik.(Some students were unable to learn effectively, possibly because they were not enthusiastic about the lesson. During the class, they were engaged in their own activities, such as resting their heads on the desk, sleeping, chatting with seatmates, or using their phones, so they didn't pay attention to the teacher or follow the lesson properly.)" (Pre-service Teacher – PPG Student).

"Siswa yang tidak dapat mengikuti kegiatan pembelajaran dengan baik hari ini adalah siswa di bangku belakang yang didominasi oleh laki-laki. Beberapa dari mereka terlihat berbicara, tidur, dan bermain HP selama pelajaran. Selain itu, siswa perempuan di bagian tengah juga ada yang lebih asyik bermain dengan temannya, mengabaikan materi yang sedang diajarkan. (The students who had difficulty participating in the learning activities today were mostly male students sitting at the back. Some of them were talking, sleeping, or using their phones during the lesson. Additionally, some female students sitting in the middle were also distracted, playing with their friends and ignoring the material being taught.)" (Pre-service Teacher – PPG Student).

The behavior shown by students during learning that indicates these problems include; students who tend to be passive during discussions, joking with their friends, and playing gadgets while the teacher explains. This has an impact on slow task completion and is not consistent with the learning agreement. From the behavior shown by these students, it is an early indication that students have problems in self-regulation. According to Bayantari et al. (2022), the inability of students to complete tasks optimally is due to the inability of students to manage the stimulus provided during the learning process. This problem is then further analyzed through a self-regulated learning questionnaire which is presented in Table 5 below.

Table 5. Results of students' initial self-regulated learning analysis questionnaire.

Aspects	Frequency distribution			
	Not very good	Not good	Good enough	Good
Forethought phase	0	8	27	1
Performance phase	0	10	23	3
Self-reflection phase	0	3	33	0
Self-regulated learning	0	7	27	2

Based on the table above, students have a fairly good ability in the planning phase, namely determining the learning strategy to be used and organizing themselves in preparation for learning. However based on SRL questionnaire, students still lack a sense of obligation in completing school assignments, especially in chemistry learning. Students have also been able to apply cognitive and metacognitive strategies during the implementation phase of chemistry learning in the classroom. However based on SRL questionnaire, students still have difficulty in monitoring and controlling emotions and motivation in carrying out learning activities that have been designed by the teacher. Students have a fairly good ability to determine strategies to overcome failures in learning and evaluate learning outcomes. However based on SRL

questionnaire, this is not accompanied by the desire to review the results of their own work. Among the three phases of self-regulated learning above, students experience many difficulties in the implementation phase which results in low self-regulated learning ability in this phase. This finding further strengthens the observations of the observers during the lesson study.

At this stage of the analysis, a needs analysis of the learning media needed by students and teachers was also carried out. The needs analysis was carried out by distributing questionnaires to students and teachers about the methods and learning media used and expected in learning chemistry. The results of the needs analysis are presented in Table 6 below.

Table 6. Needs analysis of learning media development

Aspect	Student Questionnaire Results		Teacher Questionnaire Results	
	Response	**Frequency**	**Response**	**Frequency**
Learning methods used in learning chemistry	Discussion	75%	Discussion	100%
	Q&A	69%	Q&A	100%
	Practicum	42%	Practicum	100%
	Lecture	56%	Lecture	100%
	Demonstration	6%	Demonstration	50%
Teaching materials used in chemistry learning	Textbook	14%	Textbook	100%
	Student worksheet	42%	Student worksheet	100%
	Module	42%	Module	100%
	UKBM	8%	UKBM	0%
	Handout	67%	Handout	100%
	Other	3%		
Learning media used in chemistry learning	*PowerPoint*	92%	*PowerPoint*	100%
	Video	50%	Video	100%
	Apps	11%	Apps	50%
	Games	19%	Games	100%
	More	0%	More	0%
The need for electronic-based learning media & teaching materials	Yes	92%	-	-
	No	8%		

The table above provides an overview of the learning methods, teaching materials, and learning media used by teachers in chemistry learning. The learning methods that are widely used by chemistry teachers include; discussion, question and answer, practicum, and lecture. Meanwhile, teaching materials used by teachers in learning chemistry in the form of textbooks, LKS, modules, and handouts. Learning media the teacher used to support chemistry learning are powerpoints, videos, and games. As many as 92% of students also stated the need for the development of electronic-based learning media to support chemistry learning. This also shows the readiness of students and facilities at school that support the technology-based learning process (Dewi et al., 2022).

From the results of the initial needs analysis questionnaire above, it shows the need for the development of electronic-based learning media. The learning media is expected to accommodate various forms of learning media that have been used in chemistry learning. The learning website can be one of the learning media solutions that can accommodate teaching materials and learning media in the form of powerpoints, handouts, LKS, modules, and learning videos. This learning website can be developed practically by using Google Sites (*G-Sites*) which can contain content in the form of images, videos, animations, text, and links and allow students to interact in discussion forums (Aulia et al., 2021; Sitepu & Herlinawati, 2022). The

G-Sites that will be developed are also expected to help students develop self-regulated learning skills, especially in the implementation phase. One of the strategies that can be used is to use the TGT type cooperative learning model. The selection of this learning model is based on research conducted by Zheng et al. (2024), which stated that there is a relationship between the TGT type cooperative learning model and students' self-regulated learning.

Design Stage

In this design stage, product design is carried out based on the results at the analysis stage, including; formulation of product development objectives, design of learning and assessment activities, and product assessment strategies. The detailed product design steps are outlined in Table 7 below.

Table 7. Description of the steps of the design stage

Design Phase	Description of Work Steps
Formulation of learning objectives	1. Formulate learning objectives based on the description of phase E chemistry learning outcomes in the Kurikulum Merdeka. 2. Determine the limitations of the material to be developed in *G-Sites*. 3. Develop a concept map of the material to be developed in *G-Sites*. 4. Arranging the flow of material presentation in the form of learning units 5. Formulate learning objectives for each learning unit
Design learning activities and assessments	1. Determine the learning mode scheme to be carried out 2. Determine the blended learning model to be used 3. Determine the learning activities that will be packaged online or offline and the learning activities that will be carried out in each phase of self-regulated learning 4. Determine the type of assessment that will be conducted 5. Determining the assessment activities that will be packaged online or offline 6. Determine the components required in the learning and assessment activities that have been formulated
Develop a product assessment strategy	1. Determine the type of testing of learning products that have been developed 2. Determining the testing instrument for the developed learning product 3. Determining the target in testing the learning products that have been developed 4. Determining the data processing strategy of the developed learning product test results. 5. Determining the evaluation strategy for students' self-regulated learning ability.

Development Stage

In the development stage, the *G-Sites* components are developed, which include material flowcharts, handouts, PowerPoints, and learning videos as teaching materials for students as well as Google forms and Quizizz as learning assessment support platforms. After all the components of *G-Sites* were developed, the page layout and appearance of *G-Sites* were arranged. The appearance of *G-Sites* is designed in a minimalist manner and has a striking combination of colors to match the characteristics of students who are mostly Generation Z (Gen Z). Gen Z is a generation born between the mid-1990s and early 2010s who likes minimalist designs and interesting color combinations (Nurdiansyah, 2024). At this stage, hyperlinks between pages in *G-Sites* and links to pages outside *G-Sites* are also made using the button maker feature in *G-Sites*. Handouts, PowerPoints, learning videos, and Google Forms

can be embedded directly in *G-Sites* so there is no need to leave the *G-Sites* page to access them. Each learning activity is also equipped with text instructions that can make it easier for students and teachers to do the learning activities that have been designed. *G-Sites* is also equipped with a user guide that provides detailed information about the features and guidelines for using *G-Sites*.

G-Sites Description

The developed *G-Sites* are learning media that can also be used as teaching materials for students on stoichiometry material, especially the concept of mole. This *G-Sites* is named *Stoichem Journey* which describes the journey in learning stoichiometry of the mole concept. Students and teachers can access this learning media through links using mobile devices, tablets, and computers connected to the internet. These *G-Sites* are developed by considering the learning activities that need to be done by students who have self-regulation in learning. Learning activities in the classroom are designed using the TGT type of cooperative learning model. The appearance of *G-Sites* on various devices is shown in Figure 2 below.

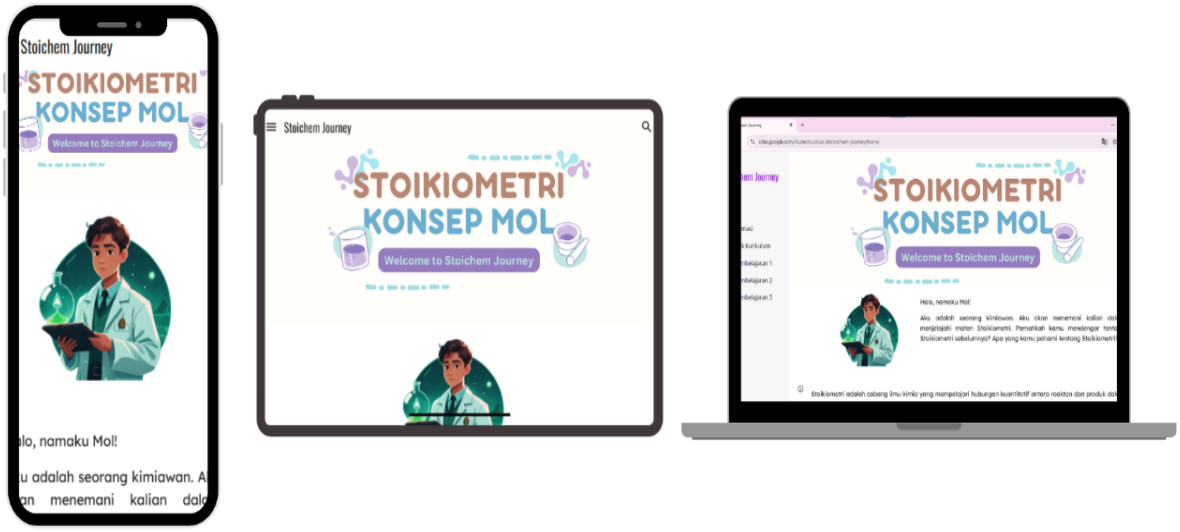

Figure 2. Display of *G-Sites* on various devices

The *G-Sites* homepage contains an introduction to the stoichiometry material to be learned. The homepage also presents a map of the journey of concepts that will be learned by students in this stoichiometry topic. At the end of the home page there is a learning unit icon that can direct students to the learning unit to be studied. There are three learning units that students will go through in *G-Sites*, including the concept of moles and molar mass; the relationship between moles and mass and volume; and substance content. The home page consists of an information sub-page that contains guidelines for using *G-Sites*, developer information, and contact information. In addition, there is also a curriculum aspect sub-page that contains information about the phase E chemistry learning outcomes, the flow of learning objectives, and learning objectives on this stoichiometry topic.

On each page of the learning unit, there are three sub-pages that correspond to the three phases of self-regulated learning: the planning phase, the performance phase, and the self-reflection phase. The sub-page for the planning phase includes an introduction, apperception, learning objectives, concept exploration, and an initial understanding check. This phase is designed to be conducted independently by students in an online mode before the face-to-face learning session. The sub-page for the performance phase includes components of the cooperative learning model using the TGT (Teams-Games-Tournament) type, which consist of class presentation, team study, games, tournament, and group rewards (Slavin, 1988). This phase is

designed to be conducted collaboratively in an offline mode during face-to-face instruction. The sub-page for the self-reflection phase includes formative assessment and self-reflection. This phase is designed to be conducted independently by students in an online mode after the face-to-face learning session. The various displays of learning resources and learning activities are shown in Figure 3 below.

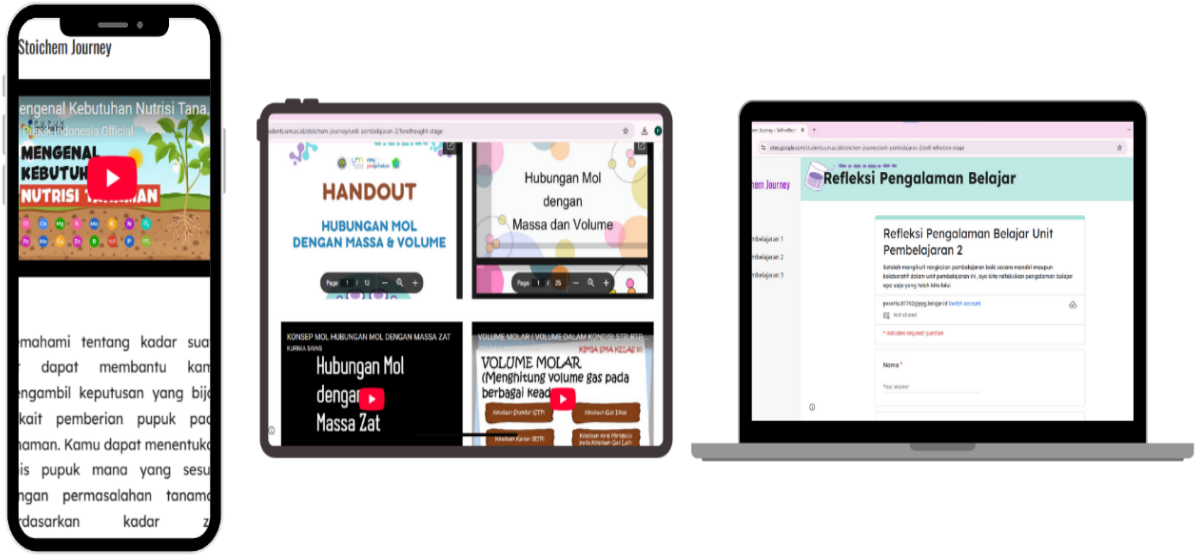

Figure 3. Features in *G-Sites* that Support the Learning Process

Validation Results

The developed *G-Sites* were then subjected to a validation test by media and content experts. The purpose of this validation is to ensure that the developed *G-Sites* meet the standard criteria as a learning medium to be used in the learning process. The validation test was conducted with two chemistry teachers at SMAN 6 Malang, who acted as the media expert and content expert validators. The assessment of the validity and feasibility of the *G-Sites* was based on several criteria in the form of scores. The scores obtained for each assessment criterion were then calculated using a percentage formula. The results of the media and content validation are presented in Table 8 below.

Table 8. Results of Validation by Media and Content Experts

Aspect	Percentage	Description
Graphic design of learning media	83%	Very Feasible
Presentation and Use of Media	80%	Very Feasible
Suitability of materials	97%	Very Feasible
Presentation of material	93%	Very Feasible
Linguistics	88%	Very Feasible
The suitability of syntax and student learning activities with the TGT type cooperative learning model	97%	Very Feasible
Self-regulated learning	100%	Very Feasible

Based on the table above, the average score for the graphic design aspect of the *G-Sites*, obtained from the media expert validation, is 83%, which is categorized as highly feasible. This indicates that the layout of components and the graphic design used in the *G-Sites* are clear, visually appealing, and harmonious. In addition, the aspect of presentation and media usage received an average score of 80% from the media expert validator. This percentage indicates that, in terms of presentation and usability, the *G-Sites* are feasible for use and meet the criteria

for ease of use and maintenance, accessibility across various devices, and sustainability as a learning media.

In terms of content relevance, content presentation, and language use, the average percentage scores obtained were 97%, 93%, and 88%, respectively. Thus, in each of these aspects, the learning media has been categorized as highly feasible for use. The content developed in the *G-Sites* aligns with the learning outcomes of phase E in the Kurikulum Merdeka and takes into account the characteristics of the students. The material is presented clearly and systematically in the form of text, images, and videos in a proportional manner, supporting students through learning processes such as active thinking, communication, data processing, drawing conclusions, and providing explanations. The language aspect of the *G-Sites* uses standard Indonesian that adheres to the Ejaan Bahasa Indonesia (EBI) and is appropriate for the students' developmental stage.

The learning activities in the performance phase, which refer to the cooperative learning model of the TGT (Teams-Games-Tournament) type, were deemed appropriate, with an average score percentage of 97% from the content expert validator, categorized as highly feasible. The developed *G-Sites* were also assessed as being capable of supporting each stage of the students' self-regulated learning process, receiving an average score of 100% from the content expert validator, also categorized as highly feasible. Based on these various aspects, the *G-Sites* developed using the TGT cooperative learning model are considered feasible for use in the chemistry learning process. Constructive feedback, suggestions, and input provided by the media and content experts were followed up by revising the developed *G-Sites* accordingly.

Readability Test Results

The validated and revised product was then subjected to a readability test involving students as the end users of the *G-Sites*. The readability test was conducted with 24 eleventh-grade students of SMAN 6 Malang who had previously received lessons on stoichiometry and the concept of the mole. In this test, the developed *G-Sites* were presented to the students, who were then asked to evaluate them by completing a readability questionnaire. This questionnaire assessed several aspects related to the use and presentation of the *G-Sites*. The results of the student readability test are presented in Table 9 below:

Table 9. Student Readability Test Results

Aspect	Average Percentage	Description
Presentation	83%	Very Feasible
Material	82%	Very Feasible
Usage	84%	Very Feasible

Based on the results of the student readability questionnaire, the overall presentation of the *G-Sites* was found to be engaging, easy to understand, informative, and comfortable to read and view. The presentation aspect of the *G-Sites* received an average score percentage of 83%, which is categorized as highly feasible. The content in the *G-Sites* is presented systematically and contextually, sparking students' curiosity and motivating their learning.

This content aspect received an average score percentage of 82%, also categorized as highly feasible. The *G-Sites* are easily accessible across various devices via link or QR code, allowing students to use them anytime and anywhere, supported by user-friendly navigation features. The usage aspect received an average score percentage of 84%. From the student readability questionnaire, most respondents gave positive feedback on the developed *G-Sites*, so no further revisions were made.

Implementation Stage

The next stage is the implementation of *G-Sites* in the chemistry learning process. This implementation phase was carried out in class X.1 at SMAN 6 Malang, which initially showed indications of low student self-regulated learning in the chemistry learning process. The implementation was conducted in only two meetings out of the three planned at the beginning of the study. This was due to the limited time available for the researcher to carry out the third planned learning session. A study by Amin et al. (2022), which implemented learning media in two sessions, demonstrated the effectiveness of using learning media. The *G-Sites* implementation was conducted directly by the researcher and observed by one chemistry teacher and two pre-service teacher candidates from the PPG (Teacher Professional Education) program.

During the first and second meetings, the learning activities were divided into three phases: the introduction phase, the main activities phase, and the closing phase. In the forethought phase, the teacher reviewed the planning phase within the *G-Sites* that students had completed independently online, which included activities such as apperception, setting learning objectives, concept exploration, and an initial understanding check. In the performance phase, the teacher conducted learning following the cooperative learning model TGT (Teams-Games-Tournament) syntax, consisting of class presentation, group study, games, tournaments, and group rewards. In the self-reflection phase, the teacher assessed students' understanding through formative assessment and asked students to reflect on the learning activities they had completed.

Evaluation Stage

The purpose of the implementation stage is to identify any improvement in students' self-regulated learning abilities after being taught using the *G-Sites* learning media. This identification process was carried out by administering a self-regulated learning questionnaire to the students both before and after instruction using the *G-Sites*. The results of the students' self-regulated learning questionnaires, before and after being taught with the *G-Sites*, are presented in the following graph.

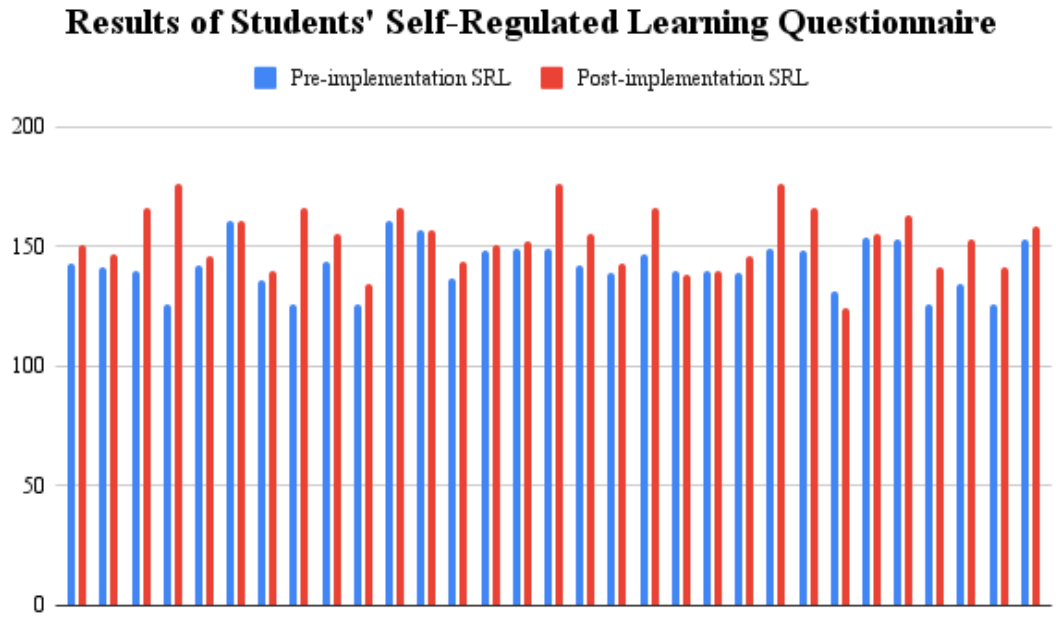

Figure 4. Results of Students' Self-Regulated Learning Questionnaire Before and After Being Taught Using *G-Sites*

Based on the graph above, there is an apparent increase in students' self-regulated learning scores after being taught using *G-Sites*. To verify this claim, a statistical test was conducted to confirm the improvement in students' self-regulated learning abilities following instruction with *G-Sites*. The statistical testing began with a normality test on both sets of self-regulated learning questionnaire scores as a prerequisite for conducting a difference test (T-test). The normality test results for the self-regulated learning scores before and after the treatment showed significance values greater than 0.05, indicating that both data sets are normally distributed and thus eligible for the difference test (T-test) (Susilowati & Rumah, 2022).

The T-test results for the two data sets showed a significance value less than 0.05, leading to the conclusion that the two data sets are not correlated (Susilowati & Rumah, 2022). Next, an N-Gain test was performed to identify the extent of improvement in students' self-regulated learning ability after being taught with *G-Sites*. The N-Gain test results indicated an improvement of 0.145, which falls into the low category.

The low improvement in students' self-regulated learning in this study may be attributed to several factors that occurred during the research, such as: the implementation stage being carried out in only two meetings, the implementation not being conducted regularly each week, and the duration of implementation not aligning with the planned time for a single meeting. All of these factors occurred due to various school agendas that the students were required to attend. The following are several excerpts from the learning observations conducted by two PPG Calon Guru Program students through the implementation of learning media.

"Pada pembelajaran hari ini, seluruh tahapan pembelajaran tidak dapat terlaksana seluruhnya. Beberapa tahapan pembelajaran tidak sempat terlaksana dikarenakan adanya keterbatasan waktu pembelajaran karena kegiatan apel pagi yang lebih lama, sehingga membuat jam pembelajaran berikutnya terpotong. Guru model menggunakan media pembelajaran berupa google site dan model pembelajaran yang digunakan adalah Team Games Tournament, sehingga sebagian besar tahapan pembelajarannya dilaksanakan dengan game. Hal tersebut cukup membuat peserta didik lebih antusias,…. (In today's lesson, not all stages of the learning process could be completed. Some stages had to be skipped due to limited time, as the morning assembly lasted longer than usual, which reduced the time available for class. The model teacher used a Google Site as the learning media and implemented the Team Games Tournament model, so most of the learning activities were carried out through games. This approach managed to increase student enthusiasm, ….)" (Pre-service Teacher – PPG Student).

"Guru model menggunakan media Google Sites dan menerapkan model pembelajaran Team Games Tournament, di mana sebagian besar aktivitas belajar dilakukan dalam bentuk permainan. Hal ini cukup meningkatkan antusiasme siswa, meskipun beberapa siswa masih terlihat tidak fokus dan kurang terlibat dalam kegiatan, (The model teacher used Google Sites as the learning media and applied the Team Games Tournament model, where most of the learning activities were game-based. This approach helped boost student enthusiasm, although some students were still seen to be unfocused and less engaged,)" (Pre-service Teacher – PPG Student).

Discussion

In developing *G-Sites* as a learning media that can support students' self-regulated learning, aspects of self-regulated learning are presented explicitly through learning activities such as apperception, formulating learning objectives, through game-based learning, and self-reflection. By making the self-regulated learning approach explicit, it is expected that students can have an awareness of the importance of self-regulated learning in the learning process because students can improve their learning outcomes and engagement in the learning process

(Yang et al., 2024). Explicitizing aspects of self-regulated learning in learning media such as *G-Sites* is a very appropriate strategy to be used in the context of blended learning (Nikolopoulou, 2023). *G-Sites* as learning media in blended learning can promote learning independence which is in line with the objectives of self-regulated learning.

During the performance phase through face-to-face learning, the observer observed that the use of game integration strategies in the learning process can increase student engagement during learning. Students tend to be more active and fully involved in the learning process with games in the learning stages. This is in line with research conducted by Srimuliyani (2023) and Mustika Sari et al. (2020) which shows the integration of games in learning can increase engagement and critical thinking skills. These critical thinking skills arise, because in the game students are required to be able to think strategically and tactically to win the game. Organizing strategies to complete the game is also part of the self-regulated learning process in the implementation phase (Zimmerman, 2002).

In the self-reflection phase, students evaluate the knowledge they have gained through the learning process through formative assessment. In addition, students also fill out a self-reflection questionnaire which aims to provide space for students to review the learning experience that has been obtained to become evaluation material for the next lesson. Self-reflection activities have an impact on improving self-regulation and cognitive abilities of students as research conducted by Alfiah et al. (2018). The N-Gain test results that show an increase in students' self-regulated learning abilities after being taught using *G-Sites* further support the evidence that the *G-Sites* product developed can support students' self-regulated learning.

CONCLUSSION

This study successfully produced a *G-Sites* product using a cooperative learning model that supports students' self-regulated learning. The developed product was declared valid and feasible for use, with percentage scores as follows: 83% for graphic design; 80% for media presentation and usage; 97% for content relevance; 93% for content presentation; 88% for language; 97% for syntax conformity; and 100% for alignment with self-regulated learning principles. The implementation of *G-Sites* was proven to increase students' self-regulated learning by up to 14.5%.

RECOMMENDATION

This study has limitations in terms of implementation time. For teachers, it is hoped that they can continuously utilize the developed *G-Sites*, as it can help train students' self-regulated learning abilities. For researchers, it is expected that they explore other learning models that can further optimize students' self-regulated learning.

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