

Development of Web-Based Biology Learning Website on Sex Education to Improve Self-Regulation among Eighth-Grade Students

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Abstract

Purpose: This study set out to develop a web-based biology learning medium focused on sex education material, to measure how feasible that medium is, to capture how eighth-grade students respond to it, and to examine its influence on their self-regulation at SMP Negeri 36 Bandar Lampung.

Methodology: The work used a research and development approach built on the Alessi and Trollip model, which moves through planning, design, and development stages. The finished product was validated by media, material, and language experts and was then tried out with twenty-nine eighth-grade students. Data came from validation sheets and response questionnaires and were analyzed with descriptive percentage techniques.

Results: Media experts rated the product at 97%, language experts at 93.75%, and material experts at 92.45%, all falling in the very feasible category. Student responses reached 88 for the website itself and 97% for the sex education content, both very positive, while self-regulation averaged 78.4%, a good level.

Conclusions: The website is feasible and workable as an independent learning medium that supports self-regulation. Limitations: The trial involved only one small class, so the results cannot yet be generalized.

Contributions: The study gives schools a trustworthy digital option for teaching sensitive reproductive health topics.

Keywords: *Biology Learning Media, Reproductive Health, Self Regulation, Sex Education, Web Based Learning*

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1. Introduction

Information and communication technology has reshaped the way people learn, and schools now sit under real pressure to translate that shift into everyday classroom practice. The move toward digital tools accelerated during the recent pandemic and, importantly, it did not fully reverse once face-to-face teaching returned, so many teachers continue to blend online resources into their lessons (Pozo et al., 2024). Studies of higher education report the same trend, showing that thoughtful technology integration can lift both teaching quality and student performance when it is matched to clear pedagogical goals (Panakaje et al., 2024). Even so, integration is far from automatic, and teachers still wrestle with limited infrastructure, uneven training, and the challenge of choosing media that genuinely fit their content (Theodorio et al., 2024). Alongside these efforts, a growing body of evidence links students' digital literacy to stronger learning outcomes, which suggests that

well-designed digital media can do more than deliver content, since they can also cultivate the habits learners need to study on their own ([Yuan et al., 2025](#)).

Biology, as a subject rich in processes that are hard to observe directly, benefits a great deal from media that make abstract systems visible and interactive. One topic within junior high school biology that remains difficult to teach, however, has little to do with technical complexity and much more to do with social discomfort. The human reproductive system, and the broader sex education that surrounds it, is often treated as a sensitive or even taboo subject, and that reluctance leaves many adolescents without accurate information at exactly the age when they most need it. Comprehensive sexuality education, when it is delivered well, is associated with lower engagement in risky sexual behavior among young people ([Rodríguez-García et al., 2025](#)). In Indonesia specifically, school-based programs that combine reproductive knowledge with socio-emotional learning have shown measurable short-term gains for very young adolescents ([Todesco et al., 2023](#); [Pinandari et al., 2023](#)). Regional data from West Java further confirm that adolescent reproductive health is shaped by a web of knowledge, attitude, and environmental factors rather than by information alone ([Solehati et al., 2022](#)).

The cost of leaving this gap unaddressed is not merely academic. Adolescents who lack sound guidance are more exposed to premarital sexual activity and its consequences, a pattern documented across very different national settings ([Okah et al., 2023](#); [Yedemie, 2024](#)). A large cross-national analysis covering more than 150,000 school-going adolescents found that the quality of parent and adolescent relationships, together with the availability of trustworthy guidance, is closely tied to sexual risk behavior ([Shawon et al., 2024](#)). When reliable adult sources stay silent, young people tend to fill the vacuum with peers and unfiltered online content, which is rarely accurate and sometimes harmful. This is where the psychological construct of self-regulation becomes relevant, because adolescents who can observe their own conduct, weigh consequences, and steer their behavior toward chosen goals are better protected against impulsive choices. Longitudinal research shows that patterns of self-regulation established in childhood carry forward into prosocial behavior during early adolescence ([Ritgens et al., 2024](#)), and reviews of adolescent self-control point to its protective role across a range of health behaviors ([Nie et al., 2026](#)).

A preliminary study conducted with twenty-eight eighth-grade students at SMP Negeri 36 Bandar Lampung sharpened these general concerns into a concrete local problem. When asked which learning media they preferred, a clear majority pointed to websites rather than to books, worksheets, or video platforms, as summarized later in this article. At the same time, most of these students admitted that they did not understand sex education, that the topic was rarely addressed clearly during lessons, and that they wanted a dedicated medium to help them find accurate information. The mismatch was striking, since students were both strongly drawn to web-based learning and largely uninformed about a health topic that directly affects them. Teachers, for their part, noted that limited classroom time and lingering discomfort made it hard to treat the subject in the depth it deserves.

Taken together, these observations pointed toward a specific solution, namely a web-based biology learning medium that presents reproductive system and sex education content in an accurate, age-appropriate, and independently accessible form. Web-based learning frees students from the boundaries of time and place, letting them revisit material whenever they need it, and Indonesian development studies confirm that interactive websites can raise both interest and comprehension in science lessons ([Suryaningrat et al., 2023](#); [Puniatmaja et al., 2023](#)). Rather than replacing the teacher, such a medium extends the teacher's reach and gives students a private, reliable channel for a subject they may hesitate to ask about aloud.

This study therefore pursued four connected aims. The first was to describe the process of developing a web-based biology learning medium on sex education material for eighth-grade students. The second was to determine the feasibility of that medium according to media, material, and language experts. The third was to capture students' responses to the medium once it was used. The fourth was to examine the influence of the medium on students' self-regulation. By addressing these aims, the

study contributes a practical, validated product to a topic area that is often discussed in principle but seldom supported with concrete, classroom-ready digital tools.

2. Literature Review and Hypothesis/es Development

2.1 Learning Media and Web-Based Learning

Learning media are any physical or digital means that carry instructional messages from a source to a learner, and their central purpose is to make content easier to grasp. In science education the argument for rich media is especially strong, because many biological structures and processes cannot be seen in an ordinary classroom. Interactive multimedia that combines text, image, animation, and video has repeatedly been shown to raise students' understanding and interest, whether it is built around nutrition content, the excretory system or general science material for junior high learners ([Putri, Widodo, & Wihardi, 2022](#); [Priani, & Pertiwi, 2024](#); [Mantoviana, Advinda, Chatri, & Putri, 2023](#)). Web-based learning takes these advantages one step further by placing the material on the open internet, where it can be reached through any browser at any time. Development studies of website-based science media report gains in learning outcomes and engagement when the interface is clear and the navigation is simple ([Inayati, & Setyasto, 2024](#); [Maria, & Paidi, 2024](#)).

The appeal of the web format lies partly in its flexibility. A well-designed site lets learners move at their own pace, repeat difficult sections, and study without being tied to a fixed schedule, which is exactly the kind of independence that interactive e-modules are designed to encourage ([Nurhikmah, Hakim, & Wahid, 2021](#)). Newer tools have widened the range of what teachers can build, from Canva-based media for elementary science by [Nisyaa, Suratno, and Widodo \(2025\)](#) to augmented reality applications that strengthen creative thinking and digital literacy in junior high students ([Pakereng, Billi, Walla, & Ghunu, 2025](#)). What these examples share is a shift away from static delivery and toward media that ask something of the learner, since interaction is what turns viewing into learning.

2.2 Feasibility and Validation of Learning Media

Before any medium reaches a classroom, it must be judged fit for purpose, and in development research this judgment is formalized through expert validation. Validation typically covers several dimensions, including the usefulness of the product, the quality of its images and video, its visual design, and the accuracy of its content. Studies that develop digital media routinely report validation as a percentage score against these criteria, and they treat high scores as evidence that the product is ready for trial ([Herlika & Sahono, 2023](#); [Uzla & Fikri, 2026](#)). Instruments for measuring digital literacy and media quality have themselves been refined and tested, which lends the process a firmer methodological footing ([Lukitasari et al., 2022](#)). Because feasibility is assessed by different kinds of experts, a medium can be strong in visual design yet weak in language, so the layered structure of validation matters. Development studies of biology e-modules show that revision cycles guided by expert comment are what move a product from adequate to very feasible ([Mardin et al., 2025](#)).

2.3 Sex Education and Reproductive Health

Sex education is best understood as instruction about reproductive health, sexual development, and the responsible conduct that surrounds them, not as encouragement toward sexual activity. Reviews of school-based programs find that structured sex education is associated with healthier sexual behavior and better health knowledge among students ([Niland et al., 2024](#)). Yet delivery is uneven, and much of the debate centers on who should teach the subject and how. Parental involvement is widely seen as valuable, and scoping reviews across Europe describe both its promise and the obstacles that keep it inconsistent ([De Meyer et al., 2024](#)). Studies of parental attitudes in India and elsewhere show that adults often support sex education in principle while remaining uncertain about content and timing ([Joshi et al., 2024](#)), a tension that validated attitude instruments have been created to measure ([Yeo & Lee, 2023](#)). Meta-analytic evidence suggests that education which equips parents to talk with their children can improve communication and shift adolescent behavior ([Gutu et al., 2025](#)). For schools, the practical lesson is that a trustworthy, well-structured resource can lower the discomfort that surrounds the topic and give both teachers and families a common reference point.

2.4 Self-Regulation and Self-Regulated Learning

Self-regulation refers to a person's capacity to plan, monitor, and adjust their own thoughts, feelings, and actions in pursuit of a goal. In educational psychology this capacity is often framed as self-regulated learning, in which learners set targets, choose strategies, track their progress, and respond to feedback. A substantial meta-analysis found that self-regulated learning interventions improve academic achievement across online and blended settings [Xu, Zhao, Zhang, Liew, and Kogut \(2023\)](#), and a separate synthesis showed that training programs strengthen not only performance but also the strategies and motivation that underlie it ([Theobald, 2021](#)). Motivation and self-regulation are deeply intertwined, since learners who value a task are more willing to regulate their effort toward it [Bakhtiar and Hadwin \(2022\)](#), and this link extends to how students use digital learning resources in online systems. Because self-regulation is multidimensional, researchers have worked to measure it carefully, producing validated instruments for undergraduates and for younger schoolchildren ([Shi, & Yang, 2025](#); [Ebbes, Schuitema, Koomen, Jansen, & Zee, 2024](#)). Evidence from primary and secondary students consistently ties stronger self-regulated learning to higher achievement ([Ha, Roehrig, & Zhang, 2023](#)). For the present study, the key implication is that a medium giving students independent control over sensitive content may also exercise the very regulatory skills, such as attitude, time management, concentration, anxiety control, and self-testing, that self-regulation comprises.

2.5 Hypotheses Development

The literature reviewed above supports three expectations that guided this development study. The hypotheses are:

H₁: The web-based biology learning medium on sex education is considered highly feasible based on validation assessments by media, material, and language experts

H₂: Students show positive responses toward the developed web-based biology learning medium on sex education

H₃: The implementation of the web-based biology learning medium on sex education significantly improves students' self-regulation

3. Research Methodology

3.1 Research Design

This study applied a research and development design, an approach used to produce a specific product and then test whether that product works as intended. The chosen development framework was the model proposed by Alessi and Trollip, which was selected because it is purpose-built for creating instructional multimedia and moves through a compact but complete sequence of planning, design, and development ([Alessi & Trollip, 2001](#)). Development research of this kind has become common in education precisely because it bridges theory and classroom practice, generating tangible tools whose quality can be examined systematically, as design-based research reviews have documented ([Tinoca, Piedade, Santos, Pedro, & Gomes, 2022](#)). The Alessi and Trollip model shares its logic with other established frameworks such as ADDIE, which has been adapted for building digital courseware in science and related fields by [Lee, Ng, and Chen \(2024\)](#), yet it keeps the workflow focused on the media production tasks that matter most for a website.

3.2 Setting, Population, and Sample

The research was carried out at SMP Negeri 36 Bandar Lampung, located on Jalan H. Endro Suratmin, Sukarama, during the even semester of the 2021/2022 academic year. The population consisted of eighth-grade students at the school. Because the product trial was designed as a small-scale, limited test, the sample was drawn from a single class, namely class VIII F, using a systematic sampling technique in which members of the population were ordered and selected by sequence. Twenty-eight students took part in the preliminary study, and twenty-nine students participated in the product trial. This limited-class design is standard for early development research, where the goal is to gather focused feedback on a product rather than to make broad population claims. Comparable web-based media studies have relied on similar single-class trials before recommending wider testing ([Triana et al., 2026](#); [Dzulfikry et al., 2025](#)).

3.3 Development Procedure

The development followed the three stages of the Alessi and Trollip model, illustrated in Figure 1. The planning stage began with identifying the scope of the product, analyzing the characteristics of the students, gathering trustworthy sources, and holding discussions with the biology teacher. This stage surfaced the core problem, since students reported boredom with conventional media such as printed books and lecture-based delivery, and it clarified their preference for technology and video. The design stage translated those findings into a concrete plan by analyzing the concepts tied to the material, building a storyboard to sketch the intended appearance of the product, constructing a flowchart to map the structure of the site from entry to exit, and selecting the software for production. The development stage was the core of the work, where the team prepared the learning material, prepared supporting media in the form of video and posters, combined the components, built the website, conducted the trial, and revised the product. The site was produced using a content management system, WordPress, together with PHP and MySQL, which allowed the content to be organized and updated efficiently.

3.4 Research Instruments

Three instruments supported data collection. Media validation sheets examined whether the website was sound in terms of usefulness, image and video quality, color quality, and design. Material validation sheets examined the accuracy and organization of the sex education and reproductive system content. Response questionnaires captured how students reacted to the medium and to the sex education material once they had used it. Each instrument was validated theoretically through consultation with the supervising lecturers before it was used, a step that mirrors the careful instrument development seen in recent digital literacy and self-regulation research ([Zakir et al., 2025](#)). The self-regulation questionnaire was organized around five indicators drawn from the learning strategies literature, namely attitude, time management, concentration, anxiety, and self-testing.

3.5 Data Analysis Technique

Validation and response data were quantitative and were then converted into qualitative categories using descriptive percentage analysis. The feasibility of the media was calculated with the following formula, presented here as Formula 1.

$$P = (\Sigma x / \Sigma xi) \times 100 \quad (1)$$

In this expression, P is the feasibility percentage, Σx is the total of all scores given across the assessment items, Σxi is the total of all ideal scores across those items, and 100 is a constant that converts the ratio into a percentage. The resulting percentage was matched against a set of ranges in which a score of 81-100% is very feasible, 61-80% is feasible, 41-60% is adequately feasible, 21-40% is not feasible, and 20 percent or below is very unfeasible. Student response data were analyzed with a parallel formula, shown as Formula 2, which yields an average response score.

$$X = (\Sigma x / n) \times 100 \quad (2)$$

Here X is the average score, Σx is the sum of the scores, n is the number of respondents, and 100 is a constant. Response scores were then classified so that a value of 85% or above is very positive, 70 to below 85% is positive, 50 to 70% is less positive, and below 50% is not positive. The same percentage logic was applied to the self-regulation data, using the categories very good, good, adequately good, not good, and very not good, so that the influence of the medium on self-regulation could be described in interpretable terms.

4. Results and Discussions

4.1 Preliminary Study Findings

The preliminary study set the stage for the whole project by making the local problem visible. When students were asked which learning media they preferred, the responses concentrated heavily on websites, as Table 1 shows.

Table 1. Preliminary study of student interest in learning media

No.	Learning Media	Count	Percentage
1	Book	1	3.6%
2	Student worksheet	1	3.6%
3	Wikipedia	2	7.1%
4	Blog	2	7.1%
5	Website	16	57.1%
6	Video platform	5	17.9%
7	Flash media	0	0%
8	Scientific article	1	3.6%
	Total	28	100%

Table 1 indicates that 16 of the 28 students, or 57.1%, preferred websites as their learning source, far ahead of any other option, while video platforms drew a distant second at 17.9%. This strong preference for the web format, confirmed in interviews with the science teacher, gave the development a clear direction. A second set of questions probed what students actually knew about sex education, and the picture was very different.

Table 2. Preliminary study of student knowledge and needs regarding sex education

No.	Category	Count	Percentage
1	Knew about sex education	5	17.9%
2	Did not know about sex education	23	82.1%
3	Understood sex education during lessons	6	21.4%
4	Did not understand it during lessons	22	78.6%
5	Needed a web medium on sex education	20	71.4%
6	Did not need such a medium	8	28.6%

Table 2 shows that 82.1% of the students did not understand sex education, that 78.6% felt the topic was not addressed clearly during lessons, and that 71.4% wanted a dedicated web-based medium to help them learn about it. The contrast between Table 1 and Table 2 is the heart of the rationale for this study, since students were plainly comfortable with web learning yet largely uninformed about a health subject that touches their daily lives. This gap echoes national concerns that reproductive knowledge among adolescents is shaped by access and environment as much as by curriculum (Solehati et al., 2022).

4.2 The Development Process and the Final Product

Working through the Alessi and Trollip stages produced a functioning website hosted at a short, memorable address after an earlier, longer URL was simplified during revision. The planning stage confirmed the scope and the audience, the design stage generated the storyboard and flowchart that fixed the structure of the site, and the development stage assembled the content into six main menus. The structure of the site as a flowchart, in which a user opens a browser, reaches the main page, and then selects among the reproductive system material, the sex education material, video, posters, and practice questions.

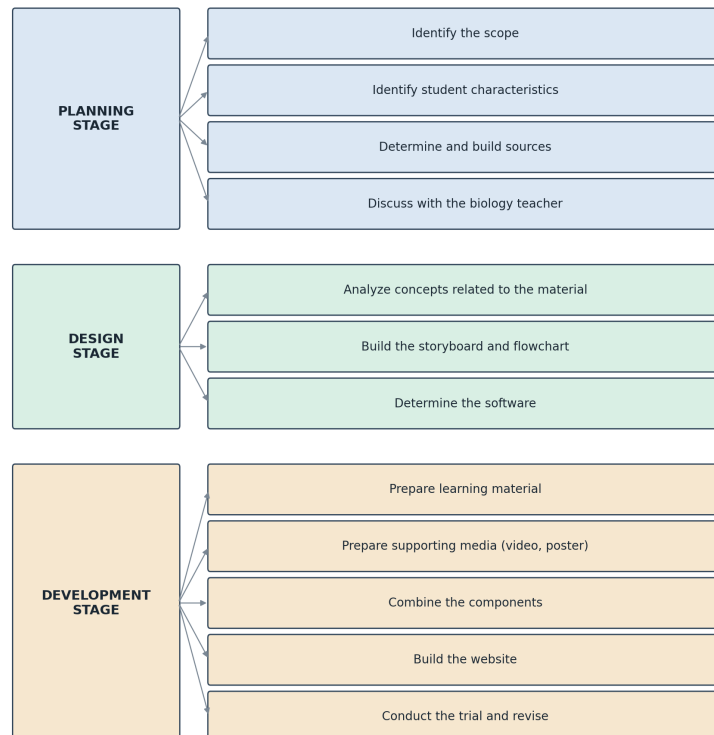


Figure 1. The three stages of the Alessi and Trollip development model

Figure 1 show the three stages of the Alessi and Trollip development model, comprising the planning stage (identifying scope, identifying student characteristics, determining and building sources, and discussing with the biology teacher), the design stage (analyzing concepts related to the material, building a storyboard and flowchart, and determining the software), and the development stage (preparing learning material, preparing supporting media, combining components, building the website, conducting the trial, and revising the product).

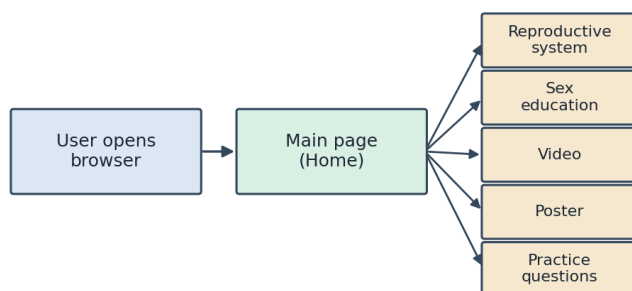


Figure 2. Flowchart of the web-based learning medium

Figure 2 show the flowchart of the web-based learning medium, showing the path from the browser to the main menu and onward to the reproductive system material, sex education material, video, poster, and practice question pages. The final product carried several strengths that surfaced during the product review. It ran on Android devices, personal computers, and laptops, it combined text with animated video and posters so that ideas were presented in more than one form, and it could be reached at any time and from any place. These qualities align with the wider finding that multimodal, interactive media ease comprehension and sustain attention in science learning (Putri et al., 2022; Rosana et al., 2024). The product also carried honest limitations, since its content was confined to the reproductive system and sex education, and it had not yet been published to a broad audience.

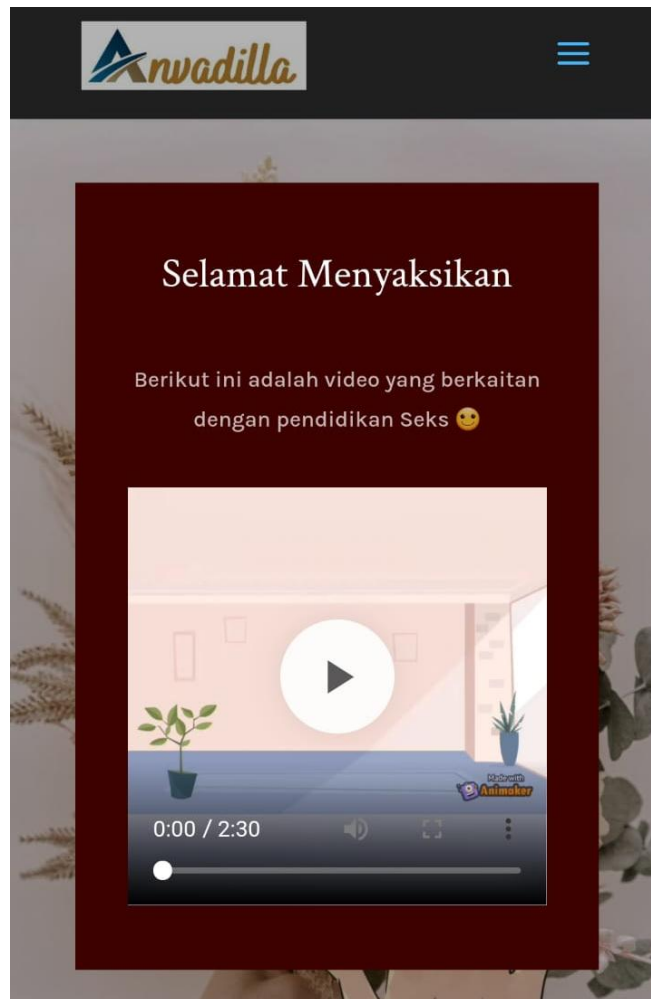


Figure 3. Sample interface of the web-based medium

Figure 3 show the sample interface of the web-based medium, showing the video page, which greets the student with the heading *Selamat Menyaksikan*, meaning welcome to watch, and presents an embedded animated video related to sex education beneath a short introduction, all under the site banner.

4.3 Feasibility of the Medium

The feasibility of the medium was established through two rounds of expert validation, an initial round followed by revision and a final round. Media validation, reported in Table 3, focused on usefulness, image and video quality, color, and design.

Table 3. Media expert validation results

Validator	Assessed aspects	Initial	Category	Final	Category
Sumarna	Usefulness, image/video quality, color quality, design	89	Very feasible	97	Very feasible

Table 3 shows that the media score rose from 89 to 97, a gain of 8 points, after the product was revised so that pages loaded quickly and menus could be selected easily. Both scores already sat in the very feasible band, and the improvement reflects refinements to the material pages, the navigation menu, and the addition of posters and video. Material validation, reported in Table 4, was carried out by two experts who judged the learning design and the accuracy of the content.

Table 4. Material expert validation results

Validator	Assessed aspects	Initial	Category	Final	Category
Azima Margareta	Learning design and material content	83.3	Very feasible	93.3	Very feasible
Sudarni	Learning design and material content	85	Very feasible	91.6	Very feasible

Table 4 shows that both material experts raised their assessments after revision, with Azima Margareta moving from 83.3 to 93.3 and Sudarni from 85 to 91.6, giving an average final score of 92.45%. The gains followed the enrichment of the material, the addition of poster content, and the completion of the practice questions, and they mirror the pattern seen in other biology media studies where expert comment drives a product upward through successive revisions ([Mardin et al., 2025](#)). Language validation, reported in Table 5, examined the clarity and appropriateness of the language for junior high readers.

Table 5. Language expert validation results

Validator	Assessed aspects	Initial	Category	Final	Category
Beli Riyadi	Language and communication, word and language use	80	Feasible	92.5	Very feasible
Rahmawati	Language and communication, word and language use	82.2	Very feasible	95	Very feasible

Table 5 shows that both language experts recorded a gain of 12.5 points, the largest single improvement in the validation process, with Beli Riyadi rising from 80 to 92.5 and Rahmawati from 82.2 to 95, for an average final score of 93.75%. The revision corrected spelling and punctuation and simplified wording so that the text matched the reading level of eighth-grade students. Taken together, the three validation strands returned final scores of 97% for media, 92.45% for material, and 93.75% for language, all firmly within the very feasible category. This result supports the first hypothesis, and it is consistent with the broader literature in which carefully revised web-based science media reach high feasibility before trial ([Herlika & Sahono, 2023](#); [Uzla & Fikri, 2026](#)).

4.4 Student Responses to the Medium and to Sex Education

Once the medium was judged feasible, it was tried out with twenty-nine students, whose responses to the website are summarized in Table 6.

Table 6. Student responses to the medium

No.	Criterion	Count	Percentage
1	Very positive	24	83%
2	Positive	5	17%
3	Less positive	0	0%
4	Not positive	0	0%
	Overall response	29	88%

Table 6 shows that 24 of the 29 students, or 83%, responded very positively to the website, while the remaining 5, or 17%, responded positively, producing an overall response score of 88% in the very positive category. No student rated the medium as less positive or not positive, which suggests that the design, navigation, and multimodal content matched what students wanted from a learning tool. This outcome is in step with development studies reporting that interactive, media-rich websites earn strong student approval when they present material through text, image, and video at once ([Mantoviana et al., 2023](#); [Inayati & Setyasto, 2024](#)).

Table 7. Student responses to the sex education content by indicator

No.	Indicator	Item focus	Count	Percentage
1	Meaning and aims of sex education	Understanding its benefit for life	29	100%
2	Meaning and aims of sex education	Knowing basic information about sex education	29	100%
3	Gender	Understanding male and female adolescent sex	29	100%
4	Gender	Heeding parental advice about mixing with the opposite sex	29	100%
5	Gender	Setting personal limits with the opposite sex	28	96.6%
6	Reproductive organs	Recognizing changes during puberty	29	100%
7	Reproductive organs	Receiving teacher information about menstruation	29	100%
8	Premarital sexual behavior	Viewing premarital sexual relations as sinful	26	89.7%
9	Premarital sexual behavior	Viewing premarital sexual relations as improper	29	100%
10	Effects of adolescent sexual activity	Teacher explanation of the danger of abortion	25	86.2%
11	Effects of adolescent sexual activity	Teacher information about sexually transmitted disease	27	91.1%
12	Effects of adolescent sexual activity	Parental explanation of the danger of free sex	28	96.6%

Table 7 shows that agreement across the twelve indicators was uniformly high, with an average of about 97% and several items reaching full agreement. The strongest responses clustered around the meaning and aims of sex education, gender understanding, and reproductive organ changes, each at 100%, while the lowest, at 86.2%, concerned teacher explanation of the danger of abortion. The very high overall figure indicates that students not only accepted the sensitive content but engaged with it seriously, which supports the second hypothesis and reflects the wider evidence that structured sex education is received well and is linked to healthier attitudes when it is delivered through a trusted channel (Niland et al., 2024; Rodríguez-García et al., 2025). The pattern also underscores a point raised in cross-national work, namely that adolescents are ready to absorb reliable guidance when it is offered clearly rather than left to chance (Shawon et al., 2024).

4.5 Influence on Self-Regulation

The final aim was to examine how the medium influenced students' self-regulation, measured across five indicators. The average results are presented in Table 8.

Table 8. Student self-regulation results by indicator

No.	Indicator	Percentage	Category
1	Attitude	85%	Very good
2	Time management	79%	Good
3	Concentration	84%	Very good
4	Anxiety	69%	Good
5	Self-testing	75%	Good
	Average	78.4%	Good

Table 8 shows that self-regulation averaged 78.4%, placing it in the good category, with attitude and concentration reaching the very good band at 85% and 84% and anxiety control sitting lowest at 69%.

The distribution behind these averages is detailed in Table 9, which reports how many students fell into each quality band for every indicator.

Table 9. Distribution of student self-regulation responses

No.	Indicator	Very good	Good	Adequately good
1	Attitude	22 (76%)	6 (21%)	1 (3%)
2	Time management	16 (55%)	12 (41%)	1 (3%)
3	Concentration	21 (72%)	8 (28%)	0
4	Anxiety	9 (31%)	10 (34%)	9 (31%)
5	Self-testing	11 (38%)	11 (38%)	6 (21%)

Table 9 shows that attitude and concentration were carried by large very good groups of 22 and 21 students, whereas anxiety was spread almost evenly across the very good, good, and adequately good bands, which explains why it recorded the lowest average. Read against the overall figure, these numbers indicate that the medium supported the more cognitive and motivational sides of self-regulation more strongly than it eased test-related anxiety, a nuance that matters for interpretation. In the original analysis the medium was found to account for 78.4% of the variation in students' self-regulation, with the remaining 21.6% attributable to factors outside the study, such as teaching method, learning style, personality, intelligence, interest, and family conditions.

This finding supports the third hypothesis and fits comfortably within the self-regulation literature. Meta-analytic evidence shows that well-structured learning environments, particularly those that give learners control over pace and strategy, strengthen self-regulated learning and, through it, achievement ([Xu, Zhao, Zhang, Liew, & Kogut, 2023](#); [Theobald, 2021](#)). A medium that lets students study sensitive material independently exercises attitude, time management, and concentration in exactly the way that motivation-focused accounts of self-regulation would predict ([Bakhtiar & Hadwin, 2022](#)). The comparatively lower anxiety result is itself informative, since it aligns with observations that the emotional dimension of self-regulation develops more slowly and is harder to shift through media design alone ([Ritgens, Bondü, & Warschburger, 2024](#); [Ha, Roehrig, & Zhang, 2023](#)). The measurement work behind these constructs, which has produced validated self-regulation instruments for learners of different ages, gives confidence that the indicators used here capture meaningful differences rather than noise ([López-Angulo, Sáez-Delgado, Gaeta, Mella-Norambuena, González-Robaina, & Muñoz-Inostroza, 2024](#); [Ebbes, Schuitema, Koomen, Jansen, & Zee, 2024](#); [Shi, & Yang, 2025](#)).

4.6 General Discussion

Placed side by side, the three sets of results tell a coherent story. A medium that experts judged very feasible drew a very positive response from students and was associated with a good level of self-regulation, which is the sequence a development study hopes to see. The pattern reinforces a theme running through recent educational technology research, namely that the value of digital media rests not on novelty but on fit, since the website succeeded because it matched a documented student preference for web learning with a documented gap in reproductive health knowledge ([Panakaje et al., 2024](#); [Yuan et al., 2025](#)). It also speaks to the persistence of digital habits after the pandemic, given that students treated an independent web resource as a natural place to learn ([Pozo et al., 2024](#)). For the sensitive subject at the center of this work, the medium offered something a crowded classroom often cannot, namely a private, accurate, and unhurried channel through which students could confront material they might hesitate to raise aloud, an advantage that the sex education literature has long argued for ([De Meyer et al., 2024](#); [Gutu et al., 2025](#); [Yedemie, 2024](#)). At the same time, the modest anxiety result and the single-class trial are honest reminders that a feasible, well-received product is a starting point rather than a finished proof, and that the influence on self-regulation, while encouraging, was measured in one setting under specific conditions ([Pinandari et al., 2023](#); [Puniatmaja et al., 2023](#); [Nie et al., 2026](#)).

There is also a design lesson worth drawing out for anyone who builds media of this kind. The steepest validation gains in this study came from language rather than from visual polish, which is a useful reminder that a scientifically accurate site can still fail its readers if the wording sits above their reading level. Simplifying the text for eighth-grade readers did as much to lift the product as any graphic did, and the same has been observed in other biology media that were revised toward clarity before they earned a very feasible rating ([Rosana et al., 2024](#); [Nisyaa et al., 2025](#)). The comment column added during revision is a small but telling feature, since it converts a one-way resource into a space where a hesitant student can ask a private question, and that small act of participation is itself a form of self-regulated learning. Read in this light, the results are less a claim that technology teaches sex education on its own and more an argument that carefully validated, learner-controlled media can carry a difficult subject further than a crowded lesson usually allows, provided teachers and families remain part of the picture.

5. Conclusions

5.1 Conclusion

This study developed a web-based biology learning medium on sex education material for eighth-grade students at SMP Negeri 36 Bandar Lampung, following the Alessi and Trollip model through its planning, design, and development stages and producing a working website that presents reproductive system and sex education content through text, images, video, posters, and practice questions. The medium proved very feasible, earning final validation scores of 97% from media experts, 93.75% from language experts, and 92.45% from material experts, all within the very feasible category. Students responded very positively, with an overall response of 88 percent to the website and about 97% to the sex education content. The medium was associated with a good level of self-regulation, averaging 78.4% across the indicators of attitude, time management, concentration, anxiety, and self-testing, and it accounted for 78.4% of the variation in students' self-regulation, with the remainder shaped by factors beyond the scope of the study. Taken together, these outcomes indicate that a carefully designed, independently accessible web medium can deliver sensitive reproductive health content effectively while supporting the regulatory skills that adolescents rely on to learn on their own.

5.2 Research Limitations

The study carries several limitations that temper how far its results can be extended. The product trial was conducted with a single small class of twenty-nine students, so the findings describe that setting rather than a broad population, and the validation drew on a small number of experts for each dimension. The content was restricted to the reproductive system and sex education, the trial ran within one academic semester, and the medium had not yet been published for wide public use at the time of the study. The influence on self-regulation was assessed through response measures during a limited trial rather than through a long-term comparison, which means the emotional dimension of self-regulation, where the lowest scores appeared, deserves closer scrutiny than a short trial can provide.

5.3 Directions for Future Study

Future work can build on these results in several practical ways. Researchers can widen the trial to multiple classes and schools, and can add more validators and respondents, so that feasibility and effectiveness are established on firmer and more generalizable ground. The medium can be extended beyond the reproductive system and sex education to other biology topics, and it can be rebuilt with alternative web development platforms to compare ease of use and reach. Longer studies that track self-regulation over time, and that pair the medium with structured teacher and parent involvement, would clarify whether the encouraging influence observed here holds and grows with sustained use. Schools, for their part, can adopt validated web media of this kind as a regular support for independent study, giving students a reliable channel for sensitive content that classroom time alone struggles to cover.

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Author Contributions

TA conceived the study, designed and developed the web-based learning medium, collected and analyzed the data, and drafted the manuscript. FGP supervised the research design and development procedure and reviewed the methodology and analysis. AH supervised the biology content and validation process and critically revised the manuscript. All authors read and approved the final version.

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