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Development of Moodle-Based Web-Based Learning with the Concept of Staged Learning Flow to Improve Learning Outcomes of Junior High School Students

Asroninaldi[1], Alwen Bentri[1], Abna Hidayati[1], Nofri Hendri[1], Rayendra[1*]

[1] Educational Technology, Postgraduate School, Universitas Negeri Padang, Padang, Indonesia.

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Corresponding Author*:
Rayendra
rayendra@fip.unp.ac.id

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Abstract: Informatics learning at the junior high school (SMP) level still faces various challenges, especially in the use of the Learning Management System (LMS) which is generally only used as a medium for distributing materials without managing the learning flow systematically. This research aims to develop Moodle-based web-based learning that integrates the concept of Staged Learning Flow to improve the quality of Informatics learning. The research uses the Research and Development (R&D) method with the ADDIE model which includes the Analysis, Design, Development, Implementation, and Evaluation stages. The research subjects consisted of material experts, media experts, linguists, Informatics teachers, and students of grade VII of junior high school. Data were collected through observation, interviews, questionnaires, and learning outcome tests, then analyzed descriptively and inferentially using eligibility percentage, Paired Sample t-test, and Normalized Gain (N-Gain). The results showed that the product obtained a validity level of 94.18% with the very valid category, a practicality level of 95.50% based on the teacher's assessment and 94.92% based on the response of students with the very practical category, and effectively improved the learning outcomes of students as shown by an increase in the average score from 56.87 to 85.73, the significance value of the Paired Sample t-test of 0.000 ($p < 0.05$), and an N-Gain value of 0.67 which included Medium category. The findings of the study show that the integration of the Staged Learning Flow concept into Moodle is able to create more structured learning, increase student engagement, and support improved learning outcomes. Thus, the Moodle-based web-based learning developed is declared valid, practical, and effective to be used as an Informatics learning medium in junior high schools.

Keywords: Informatics; Moodle; Staged learning flow; Web-based learning

Introduction

Digital transformation has changed many aspects of life, including the education system (Oktareza et al., 2024; Ghazy et al., 2025). The development of information and communication technology (ICT) has driven a paradigm shift in learning from teacher-centered learning to student-centered learning (Ayudha & Setyarsih, 2021; Suyahman, 2019; Wirani et al., 2020). In the context of 21st century education, students are required not only to master knowledge, but also to have the ability to think critically, computational thinking, creativity, collaboration, communication, and digital literacy as the main competencies in facing the challenges of the digital society (UNESCO, 2018). In line with that, the implementation of the Independent Curriculum emphasizes the importance of adaptive, contextual, and optimal use of digital technology to support a more meaningful learning process (Yanti et al., 2024).

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One of the subjects that has a strategic role in supporting the development of these competencies is Informatics. This subject not only aims to introduce the use of technology, but also to build computational thinking, problem solving, logical reasoning, and digital literacy skills of students (Bojórquez-Roque et al., 2026). Computational thinking is a fundamental skill that every individual must have in facing the digital era because it helps students formulate problems systematically and produce logical and efficient solutions. Therefore, Informatics learning should be designed to provide a learning experience that is able to develop these thinking skills gradually and continuously.

However, the implementation of Informatics learning at the Junior High School (SMP) level still faces various challenges. Learning is still dominated by conventional material delivery, while the use of learning technology has not been fully directed to build an interactive and structured learning experience. The Learning Management System (LMS) that has been used in various schools is generally only used as a medium for storing materials, assigning assignments, and collecting student work results. This condition causes the learning process to still be oriented towards material distribution (content delivery) and has not optimized the function of the LMS as a system that is able to manage the entire learning process systematically.

Moodle is one of the most widely used Learning Management Systems because it is open source, flexible, and provides various learning features such as lessons, quizzes, forum discussions, conditional activities, completion tracking, and progress tracking (Sumarwati et al., 2020). Various studies show that Moodle is able to increase learning flexibility, expand access to learning resources, and facilitate interaction between teachers and students (Munir et al., 2025). However, the implementation of Moodle in various educational institutions is still more used as a repository of learning materials than as a system that manages students' learning experiences comprehensively (Adisel, 2022; Saerang et al., 2024). As a result, students can access all the material without following a learning order that is in accordance with the level of mastery of the concept, potentially causing a gap in understanding.

From the perspective of learning design, the gradual preparation of materials is one of the important principles in increasing learning effectiveness. Cognitive Load Theory explains that human working memory capacity has limitations so that learning materials need to be organized into smaller and structured parts to reduce the cognitive load of students (Ardayeni et al., 2019; Putra & Kuntoro, 2024). Similarly, the scaffolding theory put forward by Vygotsky emphasizes that the learning process will take place more effectively if students receive assistance gradually according to the level of development of their abilities (Srimuliati et al., 2023). Meanwhile, the concept of Mastery Learning introduced by Bloom emphasizes that students should reach a certain level of mastery before moving on to the next material (Vlădescu, 2020). These three perspectives show that the success of learning is not only influenced by the quality of the material, but also by how the learning flow is systematically designed.

One approach that can accommodate these needs is Staged Learning Flow, which is an approach that organizes learning into interrelated stages so that students must complete one stage of learning before moving on to the next. This approach allows the learning process to take place in a more structured manner, reduces cognitive burden, provides continuous feedback, and helps learners build conceptual understanding gradually. The integration of the Staged Learning Flow concept into Moodle can be realized through the use of lesson module features, conditional activity, activity completion, and progress tracking, so that the LMS not only functions as a medium for delivering material, but also as a system that manages the learning flow of students systematically.

A number of previous studies have proven that web-based learning can improve students' learning outcomes, motivation, and learning flexibility (Ambarwati & Trisnawati, 2021; Gumanti et al., 2023; Jamil, 2022). Other research also develops web-based Informatics learning using Moodle and other digital platforms (Prasetyo & Wantoro, 2024). However, most of the research still focuses on the development of learning media, increased interactivity, or the provision of digital content. These studies have not developed many learning designs that integrate staged learning flow as the main mechanism in controlling students' learning progress through Learning Management System features.

Based on previous research studies, there is a research gap that shows that the implementation of Moodle is still more used as a material distribution medium than as a learning system that is able to regulate the learning sequence pedagogically. In addition, there is still limited research that integrates the principles of instructional sequencing, mastery learning, and scaffolding into Moodle-based learning designs, especially in Informatics subjects at the junior high school level. Thus, it is still necessary to develop a web-based learning model that not only provides

learning materials, but is also able to direct the learning process of students gradually according to the level of mastery of their competencies.

The novelty of this research lies in the development of web-based learning using the Moodle platform which integrates the concept of Staged Learning Flow as the basis for managing the learning flow. The developed system not only provides digital learning materials, but also implements a gradual learning mechanism through the arrangement of sequential activities, conditional activities, learning progress tracking, and continuous feedback so that students get a more systematic, directed, and competency-oriented learning experience.

Based on this description, this study aims to develop Moodle-based web-based learning by integrating the concept of Staged Learning Flow in Informatics subjects in junior high schools and testing the level of validity, practicality, and effectiveness in improving student learning outcomes. The results of this research are expected to contribute to the development of technology-based learning designs, especially in optimizing the Learning Management System as a structured digital learning environment oriented towards improving the quality of Informatics learning.

Method

This research uses the Research and Development (R&D) method which aims to produce a product in the form of Moodle-based web-based learning by integrating the concept of Staged Learning Flow in Informatics subjects in Junior High School (SMP), as well as testing the quality of the developed product. The R&D method was chosen because it allows researchers to produce valid, practical, and effective educational products through homework (Branch, 2009; Mesra et al., 2025).

The development model used is ADDIE (Analysis, Design, Development, Implementation, and Evaluation). This model was chosen because it has systematic, flexible stages, and is widely used in the development of media and technology-based learning systems (Branch, 2009; Molenda, 2015). In addition, the ADDIE model provides a comprehensive framework from needs analysis to product evaluation so that it is suitable for the development of web-based learning based on Learning Management System (LMS).

The Analysis stage is carried out through needs analysis, student characteristics analysis, curriculum analysis, and identification of Informatics learning problems in schools. Needs analysis is carried out through observation, interviews with Informatics teachers, and documentation studies of the ongoing learning process. This stage aims to identify the gap between the existing learning conditions and the expected learning conditions so that the specifications of the product to be developed can be formulated (Branch, 2009). The Design stage includes the preparation of a learning design based on the concept of Staged Learning Flow, the preparation of learning flow activities, the preparation of learning materials, evaluation instruments, system storyboards, and user interface design. The learning design is prepared based on the principle of instructional design by paying attention to the characteristics of the students, learning objectives, learning strategies, and integrated evaluation mechanisms (Hasanah et al., 2021).

The Development stage is the process of realizing the design into a web-based learning product using the Moodle platform. The product is developed by utilizing the features of lesson modules, quizzes, forum discussions, conditional activities, activity completion, and progress tracking to support the application of the Staged Learning Flow concept. Furthermore, the product is validated by material experts, learning media experts, and linguists to assess the feasibility of content, learning design, interface display, and linguistic aspects. Expert validation is an important part of development research to ensure product quality before it is implemented to users (Nieveen, 1999).

The Implementation stage was carried out through field trials on junior high school grade VII students who were the subject of the research. At this stage, the product is used in the Informatics learning process according to the learning scenario that has been designed. Teachers play the role of facilitators, while students participate in all learning activities through a web-based learning system. The implementation stage aims to obtain information about the practicality of using the product in real learning situations (Branch, 2009). The Evaluation stage is carried out formative and summative. Formative evaluation is carried out at each stage of development through expert validation and product revision, while summative evaluation is carried out after implementation to determine the level of validity, practicality, and effectiveness of the product developed (Branch, 2009).

The research subjects consist of validators and product users. Validators include material experts, learning media experts, and linguists who have competencies in their fields. Product users consist of Informatics teachers and junior high school grade VII students who use web-based learning during the learning process. The research instruments consist of expert validation sheets, teacher practicality questionnaires, student response questionnaires,

learning implementation observation sheets, and learning outcome tests in the form of pretest and posttest. The preparation of the instrument refers to the principle of content validity so that each indicator is compiled based on the learning objectives and characteristics of the product developed.

Data collection was carried out through observation, interviews, documentation, questionnaire distribution, and learning outcome tests. Observation and interviews are used at the needs analysis stage to obtain an overview of learning conditions, while questionnaires and tests are used at the implementation stage to obtain data on product practicality and effectiveness.

Data analysis was carried out descriptively and inferentially. The data of the results of expert validation is analyzed using the eligibility percentage to determine the product validity category (Riduwan, 2012).

$$P = \frac{\sum X}{\sum X_i} \times 100\ \% \quad (1)$$

The practicality of the product is calculated based on the response questionnaire of teachers and students using the following percentage formula.

$$P = \frac{\sum X}{\sum X_i} \times 100\ \% \quad (2)$$

The normality test was conducted using Shapiro–Wilk because the number of research samples was less than 50 people.

H_0 = Normally distributed data

H_1 = Data is not normally distributed

The homogeneity test was carried out using Levene's Test.

$$H_0 : \sigma_1^2 = \sigma_2^2$$
$$H_1 : \sigma_1^2 \neq \sigma_2^2 \quad (3)$$

The effectiveness of the product was analyzed using the Paired Sample t-test to determine the difference in learning outcomes before and after using web-based learning.

$$t = \frac{\bar{D}}{\frac{S_D}{\sqrt{n}}} \quad (4)$$

Decision criteria: If Sig.<0.05 then there is a significant difference between the pretest and posttest scores. On the other hand, if Sig.>0.05 is not significant, there is no significant difference.

The magnitude of the increase in learning outcomes is calculated using the Normalized Gain (N-Gain) presented by Hakke:

$$g = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}} \quad (5)$$

The average value is calculated using the formula:

$$\bar{X} = \frac{\sum X}{n} \quad (6)$$

While the standard deviation is calculated using the formula:

$$SD = \sqrt{\frac{\sum (X - \bar{X})^2}{n - 1}} \quad (7)$$

All statistical analysis was carried out using IBM SPSS Statistics with a significance level of 0.05.

Result and Discussion

Analysis Stage

The analysis stage was carried out to identify learning needs, student characteristics, Informatics learning conditions, and school readiness in implementing web-based learning. The analysis was carried out through classroom observations, interviews with Informatics teachers, documentation studies, and curriculum analysis. The results of the observation show that the Informatics learning process is still dominated by lecture and demonstration methods using presentation media. Learning Management Systems (LMS) have not been optimally utilized as a learning environment, but are more widely used to distribute materials and collect assignments. Students have not gained a structured learning experience because all materials can be accessed without paying attention to the order of competency mastery. The results of interviews with teachers show that one of the main obstacles to learning Informatics is the low involvement of students in the learning process, the difference in students' initial abilities that are quite high, and the difficulty of teachers in monitoring the learning progress of each student individually. Teachers also stated the need for learning media that is able to direct students to learn gradually according to the level of mastery of the material.

Analysis of the characteristics of students shows that most students are used to using digital devices, but their use is still dominated for entertainment and social media activities. This condition shows that students have a fairly good technological readiness, but need a digital learning environment that is able to direct the use of technology in a more productive direction. Based on the results of the needs analysis, product specifications were formulated in the form of Moodle-based web-based learning that integrates the concept of Staged Learning Flow through lesson features,

conditional activity, activity completion, quizzes, and progress tracking.

Design Stage Results

Based on the results of the needs analysis, a Moodle-based learning system was designed by applying the Staged Learning Flow concept. The learning structure is arranged in five stages, namely Introduction, Content Delivery, Guided Practice, Assessment, and Feedback. Each stage is designed using a conditional activity mechanism, so that students can only proceed to the next stage if they have completed the previous activity according to the predetermined criteria. In addition to compiling the learning flow, the design stage also produces a system storyboard, navigation structure, user interface design, database structure, and learning evaluation instruments consisting of pretests, posttests, validation sheets, practicality questionnaires, and observation sheets.



Figure 1. Initial view

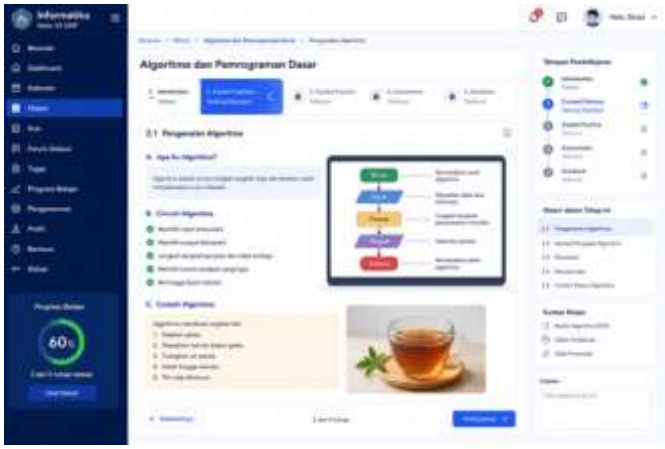

Figure 2. Material display

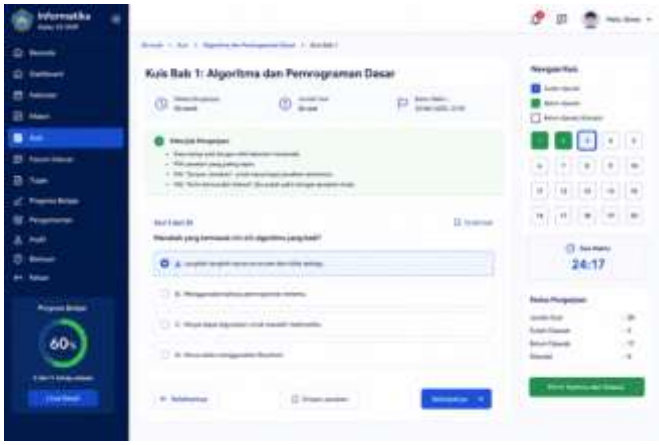

Figure 3. Quiz view

Results of the Development Stage

The development stage produces a Moodle-based web-based learning product that can be accessed through computers and mobile devices. The product is equipped with various key features such as digital materials, learning videos, discussion forums, interactive quizzes, conditional activities, lesson modules, progress tracking, and automatic feedback. Before implementation, the product is validated by three validators consisting of material experts, media experts, and linguists.

Table 1. Product validation results

Aspects	Percentage (%)	Category
Material expert	94.38	Very valid
Media expert	92.75	Very valid
Language expert	95.42	Very valid
Average	94.18	Very valid

The validation results showed that the product obtained an average feasibility of 94.18%, so it is included in the category of very valid and feasible to use at the implementation stage. The validator provided several inputs for product improvements, including the addition of user instructions on the home page, the improvement of the navigation display, the simplification of several technical terms, and the addition of illustrations to the algorithm material. All of these inputs were accommodated through a revision process before field trials.

Implementation Stage Results

The implementation stage was carried out on 30 junior high school grade VII students. Learning takes place over four meetings using web-based learning that has been developed.

Table 2. Results of teacher practicality

Aspect	Percentage (%)
Ease of use	96.00
Material suitability	95.00
Ease of learning management	94.00
Benefits of learning	97.00
Average	95.50

The results of the teacher's assessment show that the product is included in the very practical category with an average of 95.50%.

Table 3. Practical results of students

Aspect	Percentage (%)
Ease of use	94.67
System display	95.33
Ease of understanding material	93.67
Learning motivation	96.00
Average	94.92

The results of the questionnaire showed that students responded very positively to the use of web-based learning with an average percentage of 94.92%, so that the product was included in the category of very practical.

Results of the Evaluation Stage

The effectiveness of the product was analyzed through the pretest and posttest results provided before and after the use of web-based learning.

Table 4. Students' learning outcome

Variable	Mean	SD
Pretest	56.87	8.42
Posttest	85.73	6.75

There was an increase in average learning outcomes of 28.86 points after students participated in learning using web-based learning based on Staged Learning Flow.

Normality Test

The results of the Shapiro–Wilk test showed that the significance value of the pretest was 0.186 and the posttest was 0.200, so that both data were normally distributed ($p > 0.05$).

Homogeneity Test

The results of the Levene test showed a significance value of 0.421, so the data had a homogeneous variance.

Result Paired Sample t-test

Table 5. Paired test results t-test sample

t	df	Sig. (2-tailed)
-18.562	29	0

A significance value of 0.000 (<0.05) indicates that there is a significant difference between the pretest and posttest scores. Thus, the use of web-based learning based on Staged Learning Flow has a significant influence on improving student learning outcomes.

N-Gain Analysis Results

The increase in learning outcomes was calculated using the Normalized Gain (N-Gain) formula and obtained an average score of 0.67, which is in the medium category.

Table 6. N-Gain analysis results

N-Gain Value	Category
0.67	Medium

This value shows that the product developed is effective in improving student learning outcomes in Informatics subjects.

Discussion

The results show that Moodle-based web-based learning that integrates the concept of Staged Learning Flow meets the three main indicators of the quality of development research products, namely valid, practical, and effective. These findings show that the development of a Learning Management System (LMS) is not only determined by the quality of the interface and the completeness of features, but also by the learning design that is able to direct students to follow the learning flow systematically. The integration of Staged Learning Flow allows Moodle to function as a learning environment that regulates the sequence of learning activities based on the level of competency mastery so that the learning process becomes more structured.

The results of validation by material experts, media experts, and linguists show that the product obtained a very valid category with an average percentage of 94.18%. The high level of validity shows that the product has met the feasibility aspects of content, learning design, interface display, and language so that it is suitable for use in the learning process.

The quality of this validity is inseparable from the development process that follows the stages of the ADDIE model systematically. In the analysis stage, learning needs and characteristics of students are identified, while the design stage produces a learning structure that is prepared based on the concept of

Staged Learning Flow. Furthermore, at the development stage, validation is carried out by experts so that the product is refined before being implemented. Procedure by Branch (2009) which states that the ADDIE model provides a systematic framework for producing learning products that meet quality standards.

In addition, the high validity of the product also shows that the integration of Moodle features such as lesson modules, conditional activities, activity completion, and progress tracking is in accordance with modern learning design principles. According to Nieveen (1999), a learning product is said to have good quality if it meets the aspects of validity, practicality, and effectiveness in an integrated manner. Therefore, the validation results in this study are an indicator that the learning design developed is in accordance with the learning objectives of Informatics at the junior high school level.

These findings are in line with research of Segura (2026) who reported that the development of Moodle-based learning media obtained a very valid category after going through an expert validation process. Research by Fatonah & Isdaryanti (2024) also shows that the development of web-based learning provides high quality of content and learning design when developed based on the analysis of user needs. Thus, the results of this study reinforce the previous finding that the quality of LMS is greatly influenced by the application of instructional design principles from the early stages of development.

The results of the practicality test showed that teachers gave an assessment of 95.50%, while students responded by 94.92%, both of which are in the category of very practical. These results show that the system is easy to use, easy to understand, and able to support the implementation of Informatics learning effectively. The high level of practicality is influenced by the simple interface design, consistent navigation, and the application of the Staged Learning Flow concept that helps students understand the sequence of learning activities. Students no longer experience confusion in determining the material that must be studied because the system automatically directs them to follow the predetermined learning stages.

From a User Experience (UX) perspective, ease of use is one of the important factors that determine the success of the implementation of a digital learning system. According to Nurhasanah et al. (2025), the perception of ease of use, system quality, and interaction quality are the main factors that affect user satisfaction with e-learning. Therefore, the high level of practicality in this study shows that the product not only meets the technical aspects, but also provides a comfortable learning experience for users.

The results of this study also support the research by Nurwahidah et al. (2022) which states that Moodle has high flexibility as a learning platform when developed according to user needs. However, this study makes a broader contribution because it does not only utilize Moodle as a repository of materials, but also optimizes conditional activity and progress tracking features as a learning flow control mechanism.

The results of the study show that the use of web-based learning based on Staged Learning Flow is able to significantly improve student learning outcomes. This is shown by an increase in the average score from 56.87 in the pretest to 85.73 in the posttest. The results of the Paired Sample t-test showed a significance value of 0.000 ($p < 0.05$), which means that there was a significant difference in learning outcomes before and after the use of the product. In addition, the results of the N-Gain analysis of 0.67 were in the medium category, which showed that the product was effect.

The increase in learning outcomes can be explained through the Cognitive Load Theory proposed by Sweller. This theory explains that learning will be more effective if the material is presented gradually so that it can reduce the cognitive burden of students. In this study, the concept of Staged Learning Flow divides the learning process into several interrelated stages so that students can focus on one competency before moving on to the next. This approach helps students build conceptual understanding in a more systematic manner.

The findings of this study are also in accordance with the Scaffolding theory put forward by Vygotsky, which explains that students need help gradually during the learning process until they are able to learn independently. In the developed system, the assistance is realized through the sequential presentation of materials, guided exercises, formative quizzes, automatic feedback, and access restrictions using the conditional activity feature. Thus, students receive learning support that is in accordance with the development of their competencies.

In addition, the results of this study strengthen the concept of Mastery Learning proposed by Bloom. The concept emphasizes that students should reach a certain level of mastery before moving on to the next material. The implementation of the activity completion feature in Moodle allows the principle to be applied automatically so that students can only open the next material if they have completed the previous activity. This mechanism makes the learning process more directed than conventional LMS-based learning.

The results of this study are also consistent with the research by Fatonah & Isdaryanti (2024) which states that web-based learning can improve learning outcomes when designed interactively and student-centered. Research by Sun et al. (2026) shows that the quality of the online learning system has a significant effect on the satisfaction and success of students' learning. Similarly, research by Yulianti et al. (2025) found that Moodle is able to improve learning outcomes when combined with the right learning strategies.

However, this study makes a new contribution compared to previous research. Most of the previous research focused more on the development of learning media or the provision of digital content, while this study integrated the concept of Staged Learning Flow as the main mechanism in regulating the sequence of learning activities through Moodle features. Thus, the novelty of this research lies not only in the use of Moodle as a learning platform, but also in the application of instructional sequencing, mastery learning, and scaffolding principles into learning design based on Learning Management System.

Overall, the results of the study show that Moodle-based web-based learning with the Staged Learning Flow concept is able to create a more structured learning experience, increase student involvement, make it easier for teachers to monitor learning progress, and significantly improve learning outcomes. These findings show that the integration of systematic learning design into the Learning Management System is an effective strategy in supporting the implementation of Informatics learning at the Junior High School level.

Conclusion

This research has succeeded in developing Moodle-based web-based learning that integrates the concept of Staged Learning Flow as a strategy to manage the Informatics learning flow at the Junior High School level. The products developed meet the quality criteria of development research, which are valid, practical, and effective. The results of expert validation show that the product has a very high level of feasibility in terms of material, media, and language. The practicality test showed that teachers and students responded very positively to the ease of use, interface display, and benefits of the system in supporting the learning process. In addition, the results of the effectiveness test proved that the use of web-based learning based on Staged Learning Flow was able to significantly improve student learning outcomes, which was shown by an increase in posttest scores, significant Paired Sample t-test results, and N-Gain values in the medium category. These findings show that the application of the Staged Learning Flow concept not only optimizes the function of Moodle as a Learning Management System, but also contributes to the development of a more structured, adaptive, and competency-oriented learning design. Therefore, the product developed is suitable as an alternative media for Informatics learning as well as a reference in the development of LMS-based learning in other subjects.

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Author Contributions
Conceptualization, A. and A.B.; methodology, software, investigation, resources, data curation, writing—original draft preparation, visualization, A.; validation, A.H., N.H., and R.; formal analysis, M.F.; writing—review and editing, supervision, A.B. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest
The authors declare no conflict of interest.

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