Development of E-Modules Using Problem-Based Learning Flipbook Software on Class X Chemistry Material

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Abstract. The purpose of this study is to assess the viability of the Problem Based Learning learning model, which was created using flipbook software on chemistry content for class X even semester based on BSNP, and integrated with the E-Module. This report on research and development (R&D) employs the ADDIE paradigm. The study's validators included the media, R&D, language acquisition, specialists, and subject matter experts. A questionnaire with a Likert scale was used to collect the data. Both descriptive quantitative and descriptive qualitative analysis approaches are used in the data analysis process. The material validator yielded scores of 4.59, media experts 4.82, linguists 3.7, and practitioners 4.65 after validation. Following multiple validators' validation, testing was conducted in tiny classes, yielding results of 95.5% and a workable category for application..

Keywords: E-Module, Problem-Based Learning, ADDIE, R&D..

1 Introduction

Given that Indonesian education is currently ushering in the 4.0 era and places a strong emphasis on problem-solving and critical thinking skills, it is imperative that it play a significant role in ensuring that students possess effective learning abilities and skills [1–2]. Chemistry in the twenty-first century should provide students with a basis for understanding the proper concepts, according to current education, which emphasizes the 4Cs: communication, teamwork, critical thinking and problem solving, innovative thinking, and innovation [3, 4, 5].

One feature of 21st century chemistry education that is currently of great concern is the development of critical thinking abilities capable of meeting the demands of contemporary education [6]. The capacity to find information and comprehension when making judgments and resolving issues is known as critical thinking skills [7]. There are two categories for these

thinking skills: low-order (also known as low-order thinking skills) and high-order (also known as high-order thinking skills) [8]..

According to research by Harjo [9] on the Program for International Assessment (PISA) survey, Indonesia was placed sixth lowest out of all the countries that took part in these activities. These are the facts that transpired in the field. Prihatini also acquired the research outcomes. [10] corroborate the empirical data showing that pupils are better suited to solving rote questions without fully understanding the material.

Teachers work hard to help students develop critical thinking abilities, and one way they do this is by creating creative, technologically advanced learning resources [11, 12]. According to Fullan & Langworthy [13], technological advancements and digital resources can help students develop their critical thinking skills, particularly when they are leveraged to provide relevant and realistic learning experiences that let them discover, produce, and apply new information.

Teaching materials are a collection of items prepared in a methodical way to help students understand and correct the concepts of the content they are studying [14]. When instructional materials and technology work together, E-Learning is created in the form of E-Modules, which students can access and study at any time, anyplace [15]. When creating e-learning-based instructional materials, educators must take into account the needs of their students as well as the curriculum being employed [16]. The benefit of creating an E-Module is that it can be navigated interactively, displaying animation, audio, video, and graphics [17].

One learning model that can be used with the E-Module is one that links chemistry lessons to real-world situations and develops students' critical thinking abilities [18]. It also provides students with an impression of authentic experiences and fosters their ability to learn critically, reconstruct knowledge, and integrate classroom instruction with real-world learning [19].

One approach to teaching difficult chemical ideas is to create online modules that students may access at any time and from any location. Among these is the Flipbook Maker program, which may be used to incorporate educational movies. [20].

2 Text formatting

Research and Development (R&D) is the type of research that was used in this study. Teachers and lecturers are the research's subjects. R&D research is a type of study methodology that is used to develop specific goods and evaluate their efficacy [21]. The final outcome that needs to be made is an electronic flipbook-based chemistry module for class X during the even semester. The development examine used is called ADDIE (Analyst, Design, Development, Implementation, and Evaluation). In the above investigation, just three of the five stages of the ADDIE model—Analyzer, Design, and Development—were implemented. Figure 1 presents a more detailed protocol used in this investigation..
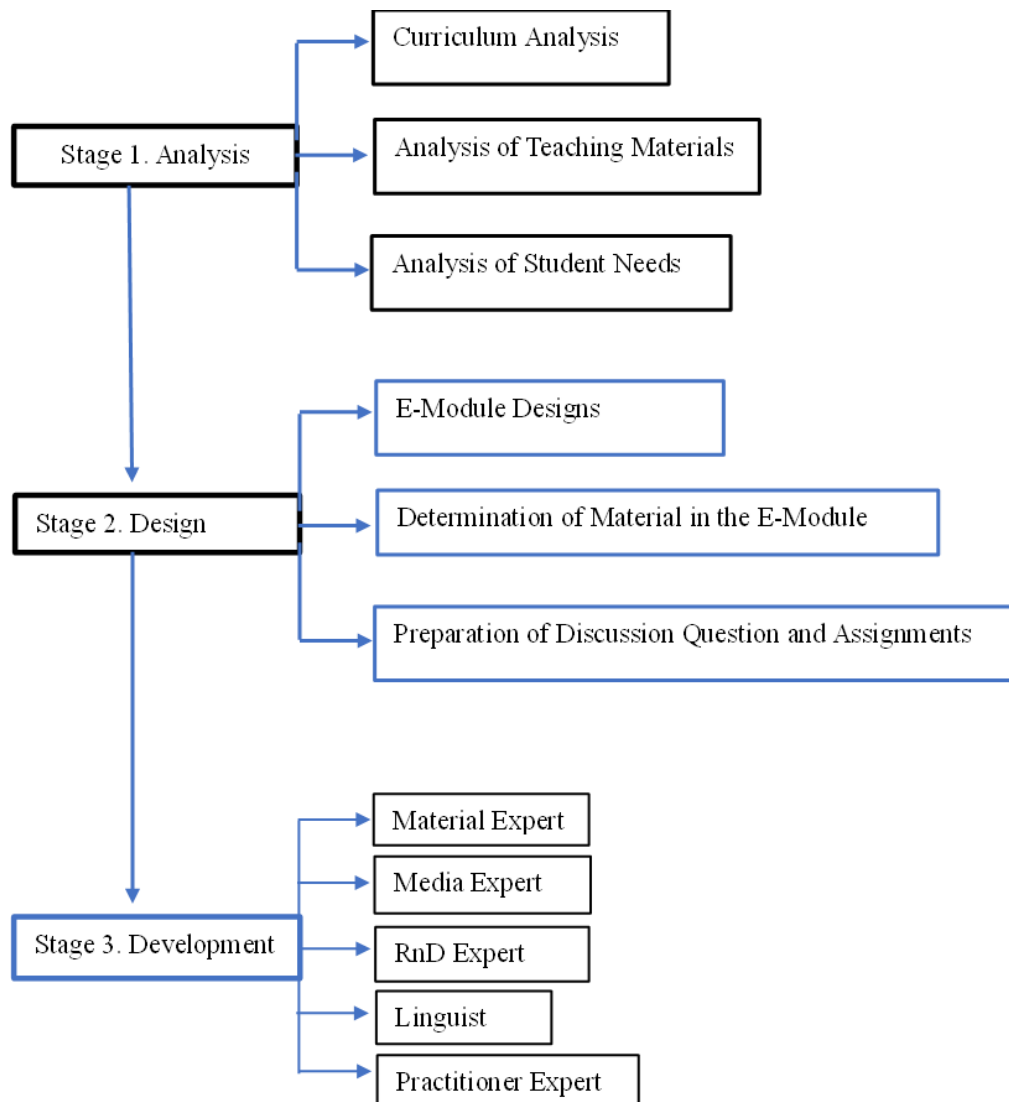
Fig. 1. Research Chart.

The method of collecting data employed by this study was a validation questionnaire sheet based on National Education guidelines Agency (BSNP) eligibility guidelines. Questionnaires had been sent to chemistry educators, Indonesian language teachers, and experts in all aspects of materials, media, and R&D. The Likert scale, with responses ranging from strongly disagree to strongly agree, is employed in the E-Module feasibility questionnaire, which is based on problem-based learning. Both a quantitative and a qualitative descriptive analysis technique were employed in the data analysis process. Table 1 provides an interpretation of the problem-based learning e-module feasibility category

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Table 1. Requirements for Average Value Analysis's Validity

Number	Interpretation
5	Excellent and does not require correction
4	Good, however certain E-Module content needs to be updated
3	Pretty good, some E-Module content needs to be revised
2	Inadequate; certain E-Module content has to be updated
1	Unsuitable and not well to utilize

3 Result and Discussion

Research and development is what this study accomplishes (R&D). The ADDIE model, which combines the steps of analyze, design, and development, is applied in this development research method.

3.1 Analyst

In order to gather the data required as material for consideration in the construction of problem-based learning-based E-Modules, an initial analysis is conducted at the analysis stage. The first analysis that was done involved determining the needs of the students for the employed instructional materials as well as the curriculum and the resources themselves. In order to gather reliable data, researchers observed ongoing learning activities, interviewed teachers, and gave questionnaires that analyzed teachers' demands. Information gleaned from interviews indicates that the learning process is still implemented using printed teaching materials, which eventually discourages students from thinking critically and being active learners. Additionally, the learning process is teacher-centered. It was discovered during observation that the teacher was solely using traditional learning models, which made the learning process dull. Based on the questionnaire answers, it was determined that the instructor required additional engaging, easily-usable, and portable teaching resources.

Teachers and students interest additional learning resources in digital format so they may be accessed anytime, anywhere, and with more ease. This is the solution to the problem. This has to do with the vast majority of educators and learners who lack access to digital instructional resources and other resources. so that education loses its appeal. In order to make these teaching materials appear appealing and simple to understand, instructors and students require additional digital teaching resources that are integrated with learning models. This is indicated by the findings of interviews, observations, and questionnaires that were used to analyze their requirements.

3.2 Design

At this design stage, the investigator generates idea maps, covers, prefaces, and several other components for E-modules based on problem-based learning. Next, compile references or materials related to the chemical topic for class X even semester, and develop discussion topics and assignments that foster critical thinking. Researchers also collect diaries, movies, animations, and photos to utilize in developing E-modules that emphasize problem-based learning. The The e-Mod based problem-based learning design is depicted in Figure 2.

Fig. 2. E-Modules Based Problem Based Learning Design.

3.3 Development

On the basis of the design process, the researcher creates a product in this step. Following the development of the problem-based learning-based E-Module, it is necessary to assess its validity by five expert validators: media experts, R&D experts, linguists, and practitioner experts.

Problem-oriented learning Three chemistry professors who are material experts examined e-modules covering every facet of content, language, presentation, and graphic feasibility. Figure 3 below shows the outcomes of the validation by material specialists.
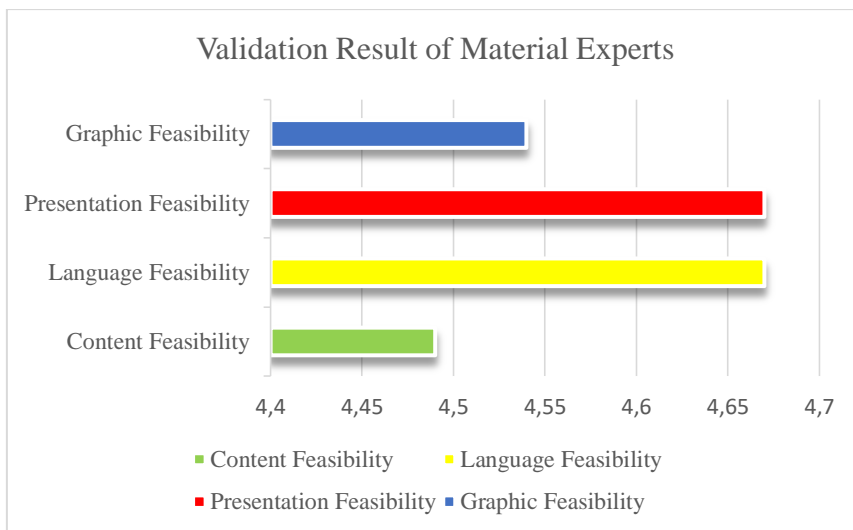
Fig. 3. Validation Result of Material Experts.

The average value, with a percentage of 91,85%, was identified by chemistry education lecturers based on the findings of evaluation by material experts. The E-Module created using a problem-based learning approach is workable and suitable for usage in subsequent research phases, it may be determined.

Someone with expertise in knowledge management, system analysis, and multimedia development does the media expert assessment. The media expert's evaluation concentrated on the presentation's viability, which was divided into three parts: program performance, informational guidelines, and systematics, aesthetics, and design principles. The comprehensive evaluation outcomes conducted by media specialists are displayed in Figure 4
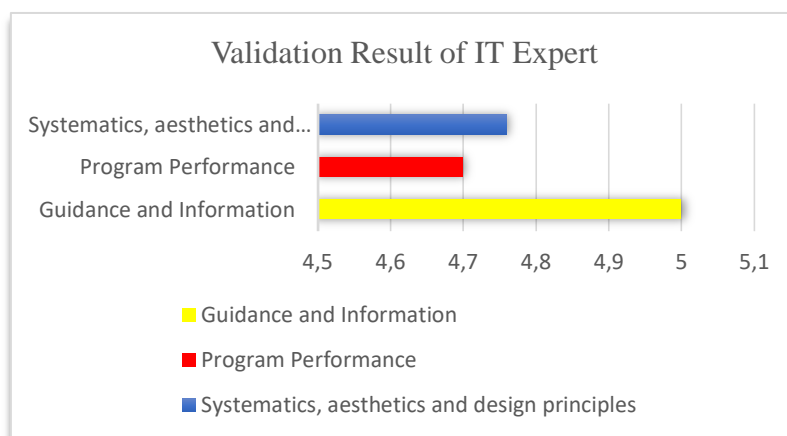

Fig. 4. Validation Result of IT Expert.

An average value of 4.82 was achieved with a percentage of 96.40% and a very feasible interpretation based on the IT expert's validation results. Hence, it can be said that the E-module created using a problem-based learning approach is very practicable and suitable for use in subsequent research phases.

To determine whether the instructional materials prepared are in line with the model in use, which focuses on multiple areas of assessment, including learning components, learning objectives, learning materials, learning models, and evaluation, assessment is conducted by R&D professionals. Figure 5 shows the specific outcomes of the R&D expert assessment.
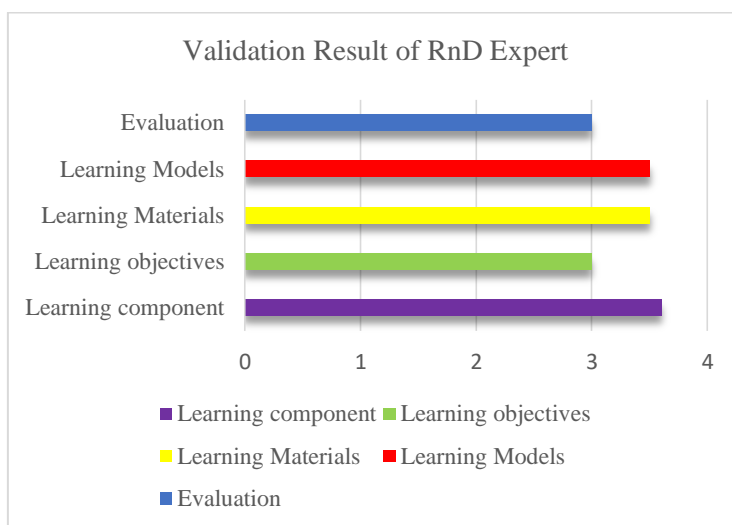

Fig. 5. Validation Result of RnD Expert.

An average value of 3.32 with an appropriate interpretation of 83% was identified based on the validation results by an R&D specialists. Hence, it can be said that the E-module created using a problem-based learning approach is very practicable and suitable for use in subsequent research phases.

In order to determine whether the E-Module being built adheres to good and proper Indonesian, a linguist conducts an assessment that focuses on multiple assessment criteria, including readability and linguistic rules. Figure 6 displays the evaluation results from the language specialists in detail
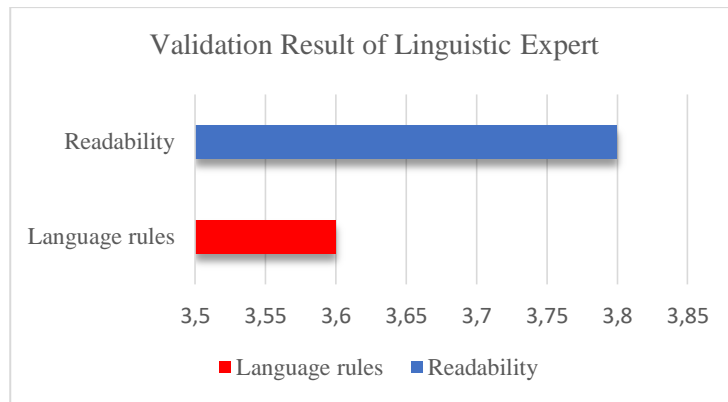
Fig. 6. Validation Result of Linguistic Expert.

With a correct interpretation, an average value of 3.7 and a percentage of 92.5% are produced based on the linguist's validation results. Consequently, it can be said that the E-module created using a problem-based learning approach is very practicable and suitable for use in subsequent research phases.

Three lecturers of chemistry undertook the material validation. Utilizing a feasibility questionnaire tool based on the BSNP, professionals validate the results. Testing is done to see whether a teaching resource, which includes content, language, presentation, and graphic components, is feasible. Figure 7 displays the outcomes of the chemistry teacher's expert practitioner's due diligence test on the E-Module, which was created using the problem-based learning approach.
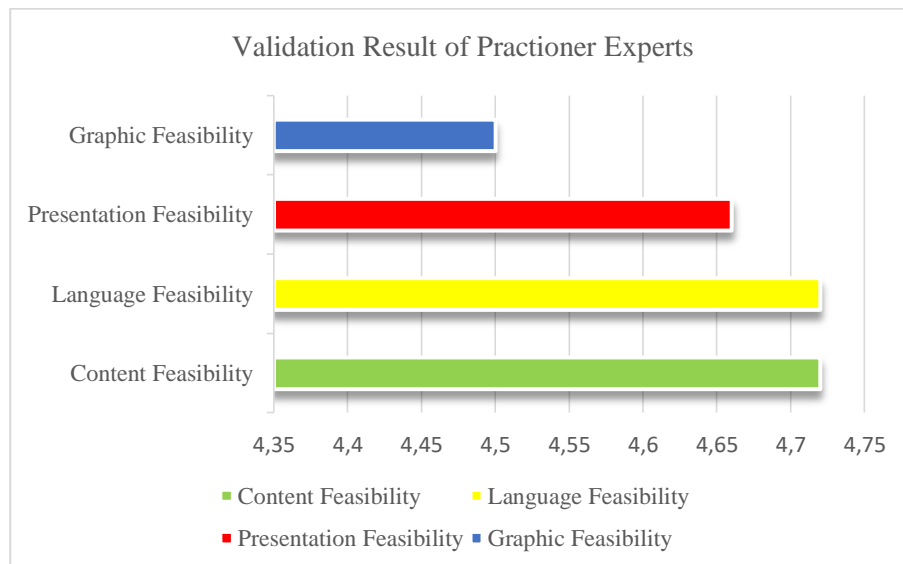

Figure 7. Validation Result of Practioner Experts.

An average value of 4.65 has been attained with a percentage of 93% with the correct meaning based on expert practitioner validation results. Consequently, it can be argued that the E-module created using a problem-based learning approach is very practicable and suitable for use in subsequent research phases.

The aforementioned validation results, which were completed by numerous skilled validators and included input from the validator, result in an E-module that is based on problem-based learning and may be utilized exactly as is. An E-module focused on problem-based learning was created using the flipbook application, and it is shown in Figure 8.
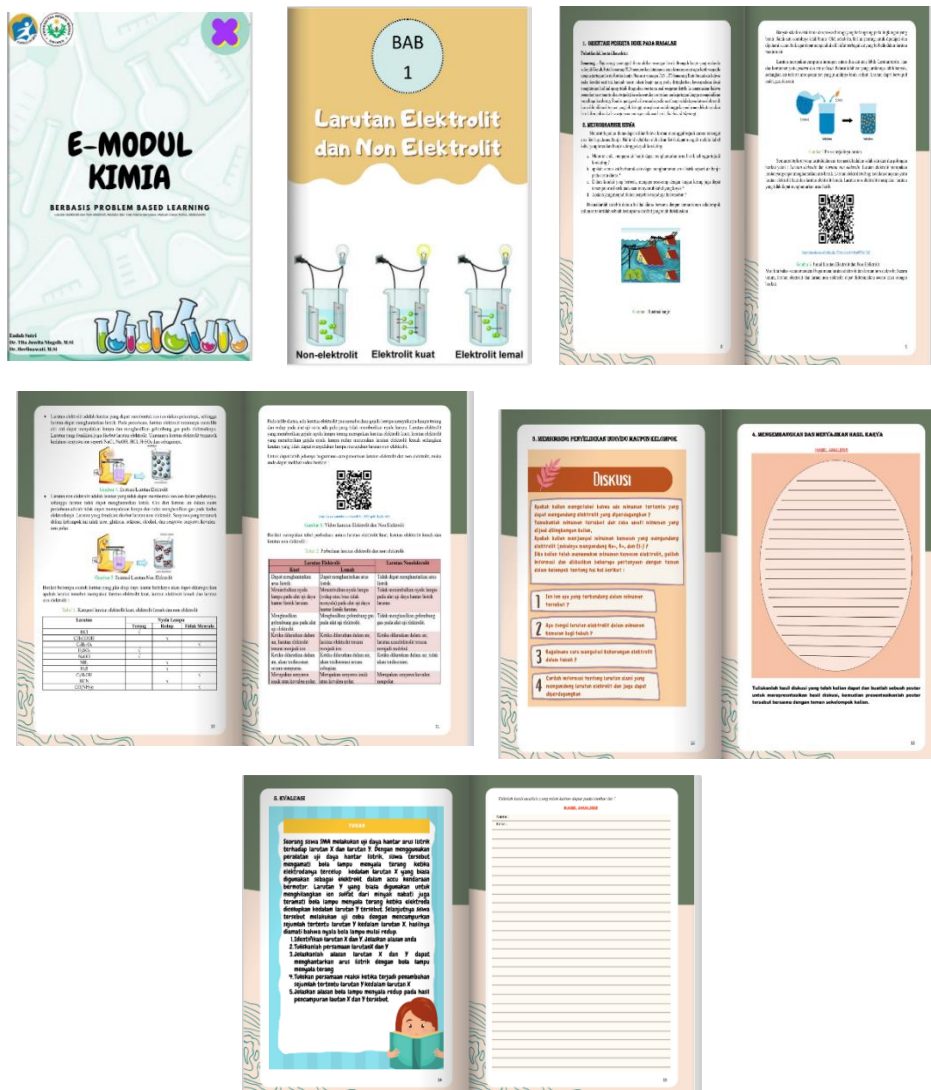

Figure 8. E-Modul Display

The product is tested while the E-Module design has been altered in accordance with recommendations from several experts and is deemed valid. It is a small-scale study that comes up next. The purpose of this trial is to determine and pinpoint any flaws, vulnerabilities, or inaccuracies in the product. Before the media product is employed at the implementation stage, the data from this trial is used as input to make adjustments..

At the present time, just ten adolescents are being tested as part of a limited trial phase. A response questionnaire was the instrument used to collect data for this a smaller scale study. Student evaluations of the caliber of the books under development were included in the questionnaire that was used to collect the data. Ten Tampahan 1 Senior High School Class XI SMA students served as the objects of this brief trial. Table 2 below lists the data from the limited trial findings.

Table 2. Limited trial results data of PBL-based E-Modules

No	Statement	Total Score	Percentage
1	The E-Module relies on PBL's display ability	3.88	97%
2	Application of the PBL-based E-Module: Some aspects	3.82	95.5%
3	Aspects regarding language in the PBL-based E-Module	3.9	97.5%
4	The advantages of PBL-based E-Modules in several aspects	3.82	95.5%

When considering that the percentage obtained from the limited trial was greater than 76%, or 96.37%, it can be concluded from the data that the students' response to the E-Module using the problem-based learning model was very good. As a result, it could be classified as very good and feasible to be tested at a later time.

It would be reasonable to draw conclusions that this investigation and creation resulted in E-Module products that use a problem-based learning approach based on the research findings. The validation findings show that material practitioners have an average value of 4.59 and a percentage of 91.85%. With a percentage of 96.40%, the average score for IT specialists is 4.82. R&D experts have an average value of 3.32 and an 83% proportion. Expert practitioners have an average value of 3.7 and a percentage of 92.5%. Expert practitioners receive an average value of 4.65 and a 93% proportion. Thus, it can be said that the product is effective and appropriate for use in the educational process. Subsequently, a restricted experiment was performed inside a small group including 10 students, yielding a results percentage of 96.37%, classifying the E-Module created utilizing a problem-based learning approach as excellent and highly practicable to be employed as.

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