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Development of E-Supplement Flipbook Material Amino Acid Compounds from Tampoi Fruit (*Baccaurea Macrocarpa*)

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Abstract

The purpose of this study was to determine the feasibility and response to E-Supplement Amino Acid in Tampoi Fruit (Baccaurea macrocarpa). This research method is research and development (R&D) with the ADDIE model consisting of analysis, design, development, implementation, and evaluation. The data collection technique in this study used measurement techniques with instruments, namely feasibility assessment sheets and response questionnaires. Data analysis used Guttman scale and average calculation. The feasibility of e-supplements was validated by two validators each. The results showed that the E-Supplement of Amino Acids in Tampoi Fruit (Baccaurea macrocarpa) has a feasibility level in the aspects of material, media, and language, which is very feasible (k = 100%). The average percentage of student responses to e-supplements is 90.94% with a very feasible category. So E-Supplement Amino Acids in Tampoi Fruit (Baccaurea macrocarpa) is very feasible to use and get a very good response from students.

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INTRODUCTION

The study of biological molecules' relationships, structure, and function in living systems is known as biochemistry. It gives students a solid basis for comprehending a variety of biological processes at the molecular level. This subject is one of the required courses for the Chemistry Education Study Program at Tanjungpura University's Faculty of Teacher Training and Education (FKIP). The variety of materials researched includes primary metabolites, micromolecules, and macromolecular substances. Amino acids are one of the materials taught, with a thorough understanding of their structure, properties, classification, and sources as well as the formation of peptide bonds and their significant role in various biological processes that support life, based on the prepared Course Learning Outcomes (CPMK). Analyzing the sources of amino acids from the surrounding environment is one of the Sub-CLOs.

This information is important because it helps us understand how different environmental sources of amino acids, such as plants and fruits, might impact our health and metabolic functions. This information is crucial for biochemistry classes because it makes biochemical principles more relatable to the natural resources in the students' immediate environment and helps them grasp how the ideas taught in the classroom are applied in real-world situations. However, there is a dearth of information on the lack of emphasis on regional natural resources, particularly with regard to amino acids present in regional fruits or plants, in the

current Chemistry Education study program at Tanjungpura University's FKIP. Expanding one's understanding of these natural resources is crucial since it may shed light on how to use local plants to make a sustainable and healthful diet. It can also make biochemistry courses more relevant and useful when considering the area in which one lives.

The fruiting plant Tampoi (Baccaurea macrocarpa) is one that is worth investigating. This unusual plant, which is native to West Kalimantan, grows in tropical rainforests and produces fruit that tastes both sweet and sour. The Dayak people also frequently utilize this fruit as a natural remedy, although more in-depth study on the fruit's ingredients has not been done. Tampoi fruit's amino acid concentration was discovered through a study that tested the fruit's skin, meat, and seeds using a variety of methods. Tampoi fruit is an intriguing secondary metabolite to research (Masriani & Fadly, 2022).

However, based on interviews with students of chemical education fkip untan, there are not many students who do not know the existence of this typical endemic fruit of West Kalimantan, many of whom think the fruit is mangosteen. Therefore, taking into account the urgency and problems that exist, a media / additional learning material (supplement) is needed to support a deeper understanding of the sources of amino acids from the surrounding environment. Students will learn more about amino acids in local fruits and plants and how to incorporate them into a sustainable and healthful diet with the aid of this supplement. Students are required to raise the relevance of the biochemistry content in the context of the local environment, expand their understanding of the potential of natural resources, and make connections between biochemistry theory and practical application using this supplemental learning material.

One of the natural resources that is distinctive of Kalimantan is tappoi fruit, which has a high level of amino acids. Though the use of Tampoi fruit enhances students' comprehension of local potential and has the ability to further scientific study in the disciplines of nutrition and biochemistry, its existence is rarely brought up in biochemistry classes. There is a disconnect between the biochemical theories that students study and the reality that they encounter when learning materials are not connected to local resources. This highlights the need for learning materials on biochemistry to have a more regional and current perspective. Students get an appreciation for the natural abundance around them by learning about scientific ideas and understanding how biochemistry may be used in the local context through the introduction of local resources like Tampoi fruit.

Interactively designed learning materials, like electronic supplements, can help improve learning outcomes by enabling students to directly investigate different sources of amino acids from their surroundings, engage with data, and apply their knowledge through materials packaged according to CPMK and the most recent relevance of nearby plants. One appropriate medium to be created with this content is an electronic flipbook supplement created with Canva and Flip PDF Corporation software.

The E-Supplement Flipbook was selected as the preferred learning medium since it is the most popular and can be customized with different features to make it appear more appealing than traditional learning materials. The e-supplement flipbook is a creative and practical way to address the problems with biochemistry education, particularly the one involving the underutilization of regional resources in instructional materials. Through the incorporation of local resources like Tampoi fruit, high interactivity, and adjustable accessibility, this flipbook offers students an engaging, relevant, and simply understandable learning experience. E-supplement flipbooks can increase comprehension of difficult biochemistry subjects while simultaneously raising awareness of the possibilities of nearby natural resources. Flipbooks are becoming a more effective and motivating learning tool due to their capacity to offer content in a multimedia format and their fast updating function. As a result, including

flipbook e-supplements into biochemistry instruction is a critical first step toward more flexible, pertinent, and engaging instruction. Additionally, it enables students to acquire all necessary knowledge on their own (Vebibina et al., 2023). Flipbooks have a number of benefits, including the ability to present learning content using a combination of words, sentences, and images; they also come with colors that can draw students' attention; they are simple to manufacture, affordable, and portable; and they can enhance student learning activities (Susilana and Riyana, 2008). Another benefit of flipbooks is that they can assist students become more proficient in abstract concepts and events that are not possible to teach in a traditional classroom setting (Andarina et al, 2013).

This study is significant because it aims to address a basic issue in biochemistry education, which is the underutilization of regional resources in instructional materials. Through the use of cutting-edge learning tools like e-supplement flipbooks, Tampoi fruit is introduced as a local supply of amino acids, and this research offers a solution that is not only applicable but readily available. Students' grasp of biochemistry is enhanced by this flipbook, which also inspires them to value and investigate the possibilities of the local natural resources. As a result, the answer provided by this e-supplement flipbook is not only a technological advancement but also a teaching instrument that may stimulate local wealth-based science research and development, greatly advancing the field of biochemistry research.

METHOD

In order to build Flipbook-based E-supplement learning material, Research and Development (R&D) is a research approach that applies the ADDIE development paradigm. According to Cahyadi (2019), there are five processes in the ADDIE model: analysis, design, development, implementation, and evaluation. The implementation stage, however, was not conducted in this study since its sole objectives are to assess the viability of e-supplements and how chemical education students would react to them. The E-Supplement Flipbook Media for Amino Acid Compound Material from Tampoi Local Fruit (Baccaurea Macrocarpa) as Teaching Material for Biochemistry Courses is the topic of the study. The ADDIE approach was selected because it provides a scalable and methodical framework for creating engaging and educational content. From analysis to evaluation, every step makes it possible to identify requirements in detail, create media that is acceptable, and apply it in the learning environment in the right way. The developed flipbook e-supplement can be more optimal in overcoming the issue of underutilizing local resources, like Tampoi fruit, in biochemistry learning while improving the overall quality of education because of ADDIE's iterative nature, which allows for continuous improvement based on evaluation results. The steps of the ADDIE development model can be seen in Figure 1.

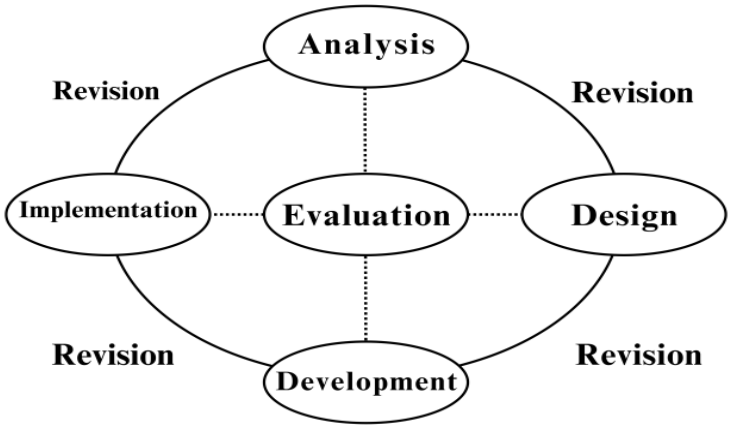


Figure 1. ADDIE Development Procedure (Branch, 2009)

The analysis stage, which comprises requirements and issue analyses, is the initial step. At this point, in-person interviews were done with instructors of the Biomolecular Structure and Function course to get insight into the course contents, as well as with Chemistry Education students in the class of 2022 to learn about their familiarity with Tampoi fruit. Storyboards for the media are made by researchers during the design stage as a first step in methodically creating items, from the cover to the contents. Additionally, researchers created grids and evaluation sheets for student reaction assessments to instructional media and validators. Making media designs in the form of storyboards, choosing the e-supplement format, and creating feasibility evaluation sheets are all part of this design step (Ersando et al., 2022). During the creation phase, Canva was used to create the e-supplements. The materials, language, and media were vetted by experts, and students were assessed using questionnaires to gauge their reactions to the e-supplement on the structure and function of amino acid biomolecules from tampoi fruit. The purpose of this development stage is to implement the planned product and evaluate its viability (Kurnia et al., 2022).

Data Collection Instruments

Indirect communication techniques, such as the distribution of questionnaires examined using a Guttman scale, were employed in this study's data gathering. Because it can assess answers in an organized and consistent way, this scale was selected. According to Puspasari's (2019) assessment, the questionnaire was created using instruments that had been constructed to gather data about the product under development. Expert assessment data was processed and evaluated according to predefined standards, offering precise direction for future product development.

Table 1. Criteria for interpretation of feasibility assessment scores

Percentage (%)	Category
0 - 20	Not Feasible
21 - 40	Less Feasible
41 - 60	Fair Feasible
61 - 80	Feasible
81 - 100	Very Feasible

(Asyhari & Silvia, 2016)

The criteria for interpreting the feasibility assessment score can be obtained by calculating using the formula:

$P = \frac{f}{N} \times 100\%$

Description:

P : The percentage

f : The number of expert scores

N : Maximum score of the validator (Number of experts × highest score item)

(Hidayat et al., 2022)

Categorization and weighting of scores and answers to the material feasibility instrument of the e-supplement media by experts using the Guttman scale, as follows:

Table 2. Product Validation Assessment Criteria

Statement		
Answer	Score	Percentage
Relevant	1	100%
Not Relevant	0	0%

(Sugiyono, 2019)

Calculating the response test value of 2022 Chemistry Education Students using the formula (Akbar, 2005):

V-pg = $\frac{TSe}{TSh}$ X 100%

V-pg : User Validity

TSe : Total empirical score achieved

TSh : Total maximum score

The response test percentage findings from the student response test analysis may then be used to classify the following evaluation criteria using a Likert scale:

Table 3. Criteria for interpretation of Response Test assessment scores

Percentage (%)	Category
0 - 20	Not Good
21 - 40	Less Good
41 - 60	Fair
61 - 80	Good
81 - 100	Very Good

(Riduwan, 2016)

RESULTS AND DISCUSSION

The ADDIE model, which covers the stages of analysis, design, and development, was used in this study's product development process. Nevertheless, this study has not gone through the implementation step. The following are the steps that the ADDIE model takes.

Analysis Stage

The analysis process is finished by analyzing needs and challenges. By this time, in-person interviews were conducted with Chemistry Education students in the class of 2022 to find out about their knowledge with tampoi fruit and with Biochemistry course instructors to learn more about the course materials. The results of the investigation show that students' biochemistry lessons, especially those that address the topic of amino acids, require electronic supplementation. Additionally, despite being shown the appearance of the fruit, pupils are unable to recognize or understand tampoi fruit. Supplementary books are essential for fostering students' intellectual and creative growth. One such book is one about the tampoi fruit, which is related to biochemistry studies and offers information on amino acids. This can lead to an increase in students' understanding of amino acids and the tampoi fruit, a native Kalimantan fruit that is now scarcely known.

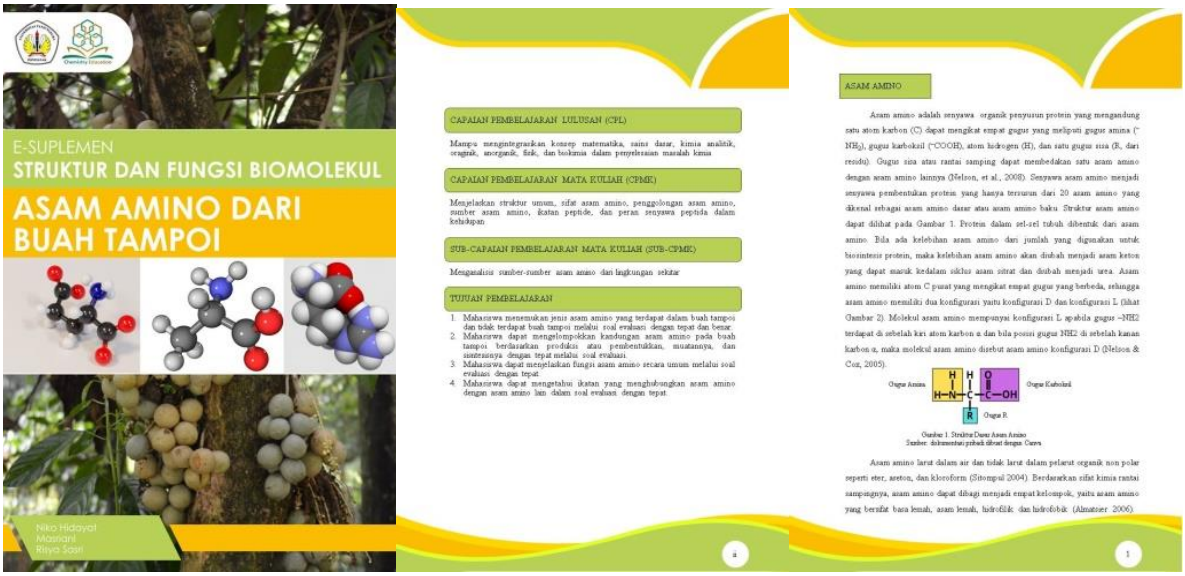
Design Stage

Storyboards with layout and content design were made for the initial learning materials throughout the design process. The flipbook e-supplement's design and content choices, including the use of storyboards, are informed by the visual learning theory, which highlights the value of visual components in enhancing student comprehension. The Cognitive burden idea, put out by Sweller in 1988, states that information visualization can lessen students' cognitive burden and help them comprehend and recall the content more readily. With the use of storyboards, material may be arranged logically and engagingly, which aids in students' progressive and methodical understanding of more complicated subjects. Furthermore, storyboards guarantee that textual and visual components complement one another. This can enhance memory retention by combining verbal and visual processing, as per Paivio's Dual Coding Theory (1986). Consequently, storyboard design in flipbook e-supplements improves the efficacy of conveying biochemical contents in an engaging and dynamic manner while

also facilitating the learning flow. In addition, the structure of the e-supplement is chosen, including the writing style and content/material. At this time, a feasibility assessment document was also produced, which included the components and assessment metrics that the validator teacher would utilize to determine whether the developed e-supplement was viable. Additionally, a form for a student response exam was created with the purpose of determining how well the instructional materials were received.

Development Stage

Scientists build electronic supplements, assess the product's feasibility in terms of content, medium, and language, and examine the responses of class A2 Chemistry Education students during the development process. The software utilized to create this electronic supplement is called Canva. Creating e-supplements is consistent with the objectives of education. The words, phrases, colors, and visuals used in the e-supplement teaching materials are specifically chosen to fit the topic in order to make the content easily understood by students. E-Supplement Products Structure and Function of Amino Acid Biomolecules from Tampoi Fruit can be seen in Figure 2.



(a) (b) (c)

Figure 2: Display of e-supplement Structure and Function of Biomolecules. a) cover view of e-supplement; b) introduction view of e-supplement; c) content view of e-supplement.

Based on the results of the assessment carried out during the development stage, a feasibility study and formative revision are carried out following the production of the product. This evaluation assesses how effectively the generated media meets Gregory's standards and gets ready for the impending field test by looking at material, media, and language factors. This product has undergone a thorough and unbiased evaluation by experts in their respective fields. In-depth examination and recommendations for improving the product's quality before field testing were part of this study.

The results showed that the e-supplement flipbook Structure and Function of Biomolecules on Amino Acid material from Tampoi Fruit was very feasible (k = 100%) in terms of content, media, and language. The feasibility assessment data by two validators for each aspect can be seen in Table 4, Table 5, and Table 6, as well as the feasibility assessment graph in Figure 3.

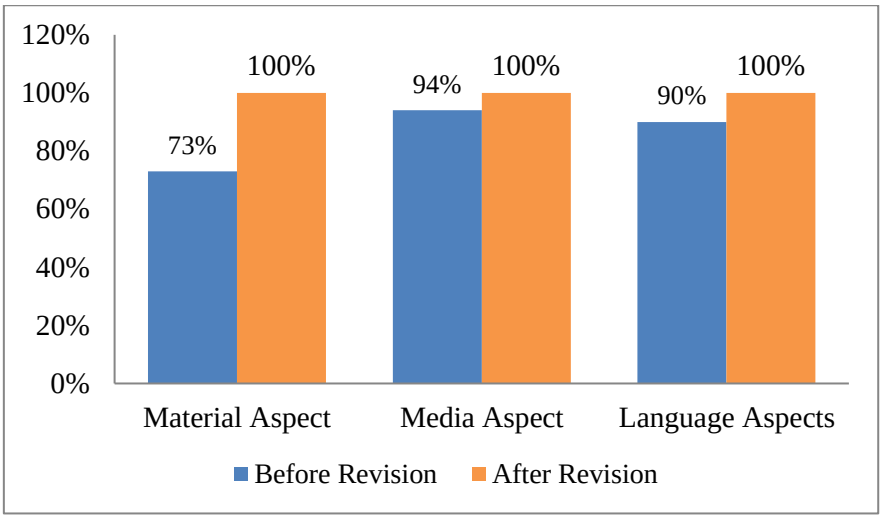
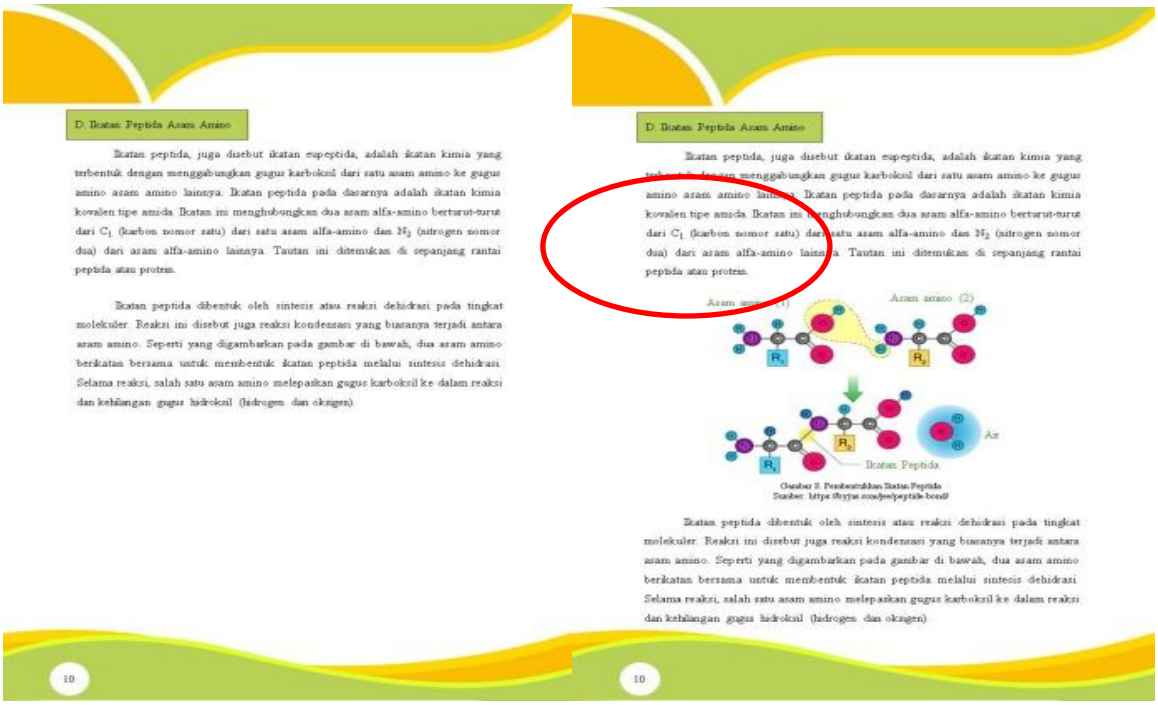


Figure 3. Graph of feasibility assessment results in material, media, and language aspects

The validators' evaluation indicates that the e-supplement has to be improved in all three categories for several reasons, such as:

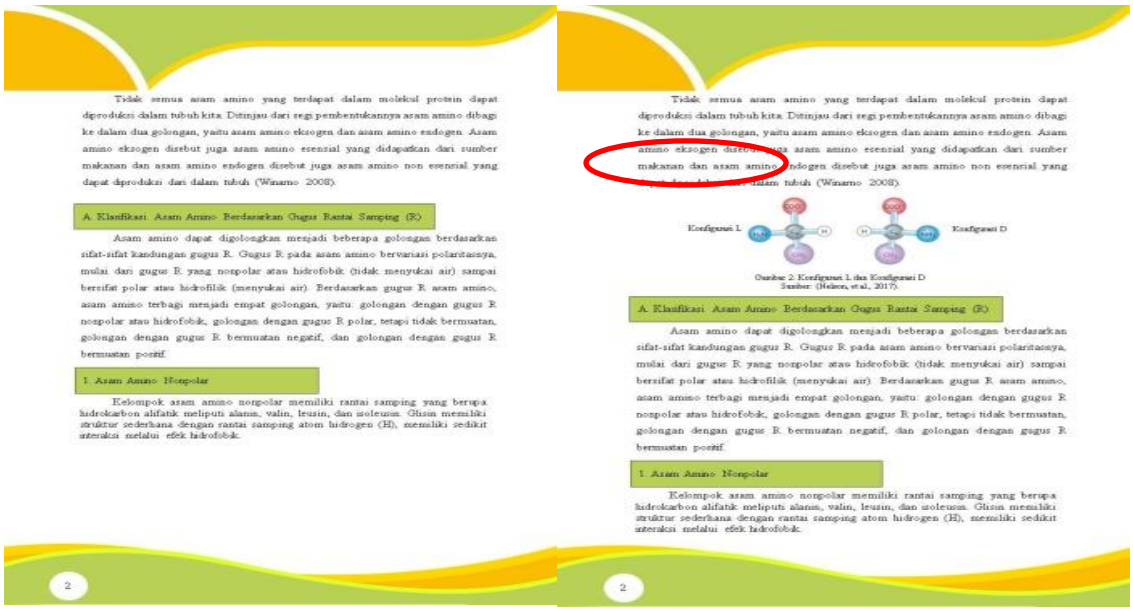
Material Aspects

Due to unclear and lacking wording, validators made six adjustments to the electronic supplements in the material aspect. More subcontents, such as information on the mechanism of peptide bonds and examples of configurations L and D on amino acid structures, should be included to the e-supplements in order to improve the material presentation indicators. This subcontent was included in an effort to assist elucidate some of the most enigmatic themes in the e-supplement. If you give them a more thorough explanation, they will have an easier time understanding the lesson's topic. The information must be presented carefully and in line with the learning objectives, claims Rahdiyanta (2015). Some of the results of the e-supplement revision on the material aspect can be seen in Figure 4 and Figure 5.



Before Revision After Revision

Figure 4. Revision of material on peptide bond mechanism



Before Revision After Revision

Figure 5. Revision of material on L and D Configuration of Amino Acids

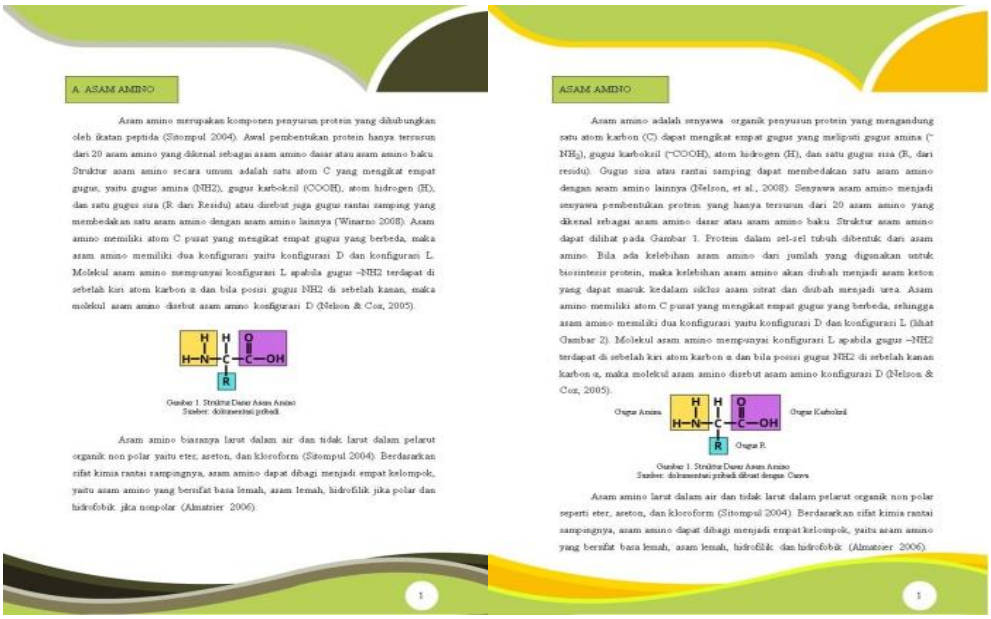
Table 4. Data on the results of the material feasibility assessment from two validators

Indicator	Number of Statements	Average Assessment of Validator 1	Average Assessment of Validator 2
Suitability of material with ELOs	3 (no 1-3)	100%	100%
The accuracy of the material	3 (no 4-6)	100%	100%
Up-to-date material	2 (no 7-8)	100%	100%
Encourage curiosity	1 (no 9)	100%	100%

Media Aspects

The media aspect receives only one revision, but it includes multiple displays that should be taken into consideration and made better so that the developed media can be enjoyed. For example, the quiz menu in the evaluation question section could be added to make the media more visually appealing, and the layout color should be changed to match the colors of the tampoi fruit and Structure and Function of Biomolecules material. In order to enhance readability and student comfort throughout the learning process, the media portion of the flipbook e-supplement was revised by making improvements to the color and layout. In order to guarantee that the text is simple to read and to lessen eye fatigue throughout the learning process, the contrast between the text and the backdrop was enhanced, adhering to the rules of color theory.

To create a confortable environment while drawing attention to crucial information, softer yet still striking colors were used. Furthermore, the layout was modified in accordance with Gestalt principles, which stress that pupils are better able to comprehend and classify information when visual elements are arranged in a structured and ordered manner. The learning process is made more effective and efficient when there is a clear and organized arrangement that makes it easier for pupils to explore the flipbook and follow the flow of the content. An effective e-supplement format should have a paper size that is suitable for the content being provided, employ easily understood iconography, and have a consistent paper orientation (horizontal or vertical) (Mulyana et al., 2019). Some of the results of the e-supplement revision in the media aspect can be seen in Figure 6.



Before Revision After Revision

(a)

Before Revision After Revision

(b)

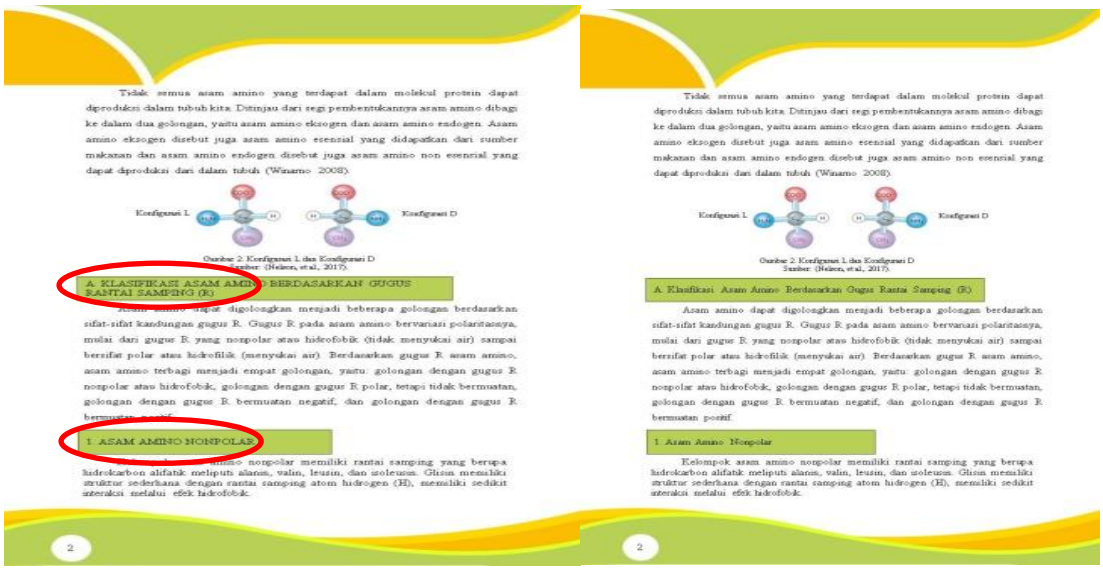
Figure 6. Revision of e-supplements on the media aspect. a) revision of material about the layout or layout of the media b) revision of material about the addition of a quiz menu on evaluation questions

Table 5. Data on media feasibility assessment results from two validators

Indicator	Number of Statements	Average Assessment of Validator 1	Average Assessment of Validator 2
E-Supplement Size	2 (no 1-2)	100%	100%
E-Supplement Cover Design	8 (no 3-10)	100%	100%
E-Supplement Content Design	9 (no 11-19)	100%	100%
Application	6 (no 20-25)	100%	100%

Language Aspect

The language element had a single adjustment, which involved fixing capitalization problems in phrases within the e-supplement and modifying the previously inconsistent capitalization guidelines for titles and subtitles of resources. The evaluation of language feasibility include the precision of sentence structure and efficacy, the standardization of terminology, the comprehension of communications and data, and the correctness of syntax and spelling. The goal of evaluation based on these metrics is to create media that facilitates students' comprehension of the subject matter. Easy to comprehend language is considered good language (Sugono, 2009; Kustanti, 2017). Some of the revised e-supplements related to linguistic aspects can be seen in Figure 7.



Before Revision After Revision

Figure 7. Revision of e-supplements in the language aspect, namely writing capital letters in the sub-title of the material

Table 6. Data on the results of the language feasibility assessment from two validators

Indicator	Number of Statements	Average Assessment of Validator 1	Average Assessment of Validator 2
Straightforward	3 (no 1-3)	100%	100%
Communicative	1 (no 4)	100%	100%
Conformity with rules	2 (no 5-6)	100%	100%

Expert validators deemed previous study utilizing e-supplements, Green Chemistry e-supplements, to be feasible to utilize as supplementary / supporting instructional resources. The e-supplement may be utilized for learning since, according to highly realistic criteria, the average percentage achieved from both validators is 98% (Hariyanti et al., 2024).

Student Response Test

After the e-supplement on the biomolecular structure and function of amino acids from tampoi fruit was validated by material, media, and language specialists, 28 chemical education students in the class of 2022 were requested to test it. The purpose of this study is to see how the generated e-supplements affect pupils. The students will assess the e-supplement based on the learning materials, content, and benefits listed in the student response form. With an average percentage of 90.94%, students responded well to the trial construction of e-supplements on the structure and function of amino acid biomolecules from Tampoi fruit. These results show that, in terms of learning media, content, and benefits, 2022

chemical education students have responded well to E-Supplement Biochemistry of Amino Acids from Tampoi Fruit. The response test results can be seen in Table 7.

Table 7. Data on Response Test Results of Chemical Education Students Class of 2022 to E-Supplement Biochemical amino acids from tampoi fruit

Indicator	Number of Statements	Average Student Response Test Assessment
Learning Media	3 (no 1-3)	91,67%
Material	10 (no 4-13)	90,78%
Benefits	3 (no 14-16)	90,71%
Average		90,94%

CONCLUSIONS

The Structure and Function of Biomolecules of Amino Acids from Tampoi Fruit e-supplement has been deemed appropriate for use as an additional or supplemental educational resource by expert validators. With 100% ratings for content, media, and language in every area and incredibly realistic criteria, the e-supplement may be used for learning. The 2022 class's chemistry education students also gave the e-supplement Structure and Function of Biomolecules of amino acids from tampoi fruit a positive review, rating 90.94%. It is evident from the validation results by experts that this flipbook e-supplement is both unique and workable as an extra learning resource. This e-supplement is special because it introduces and uses locally produced content (such Tampoi fruit, which is a source of local amino acids in biochemistry material) that is seldom cultivated. This raises the material's instructional value and makes it more pertinent to Indonesia's natural resources, enhancing students' understanding of local wealth while also making it an informative learning tool.

RECOMMENDATIONS

Updates are needed for the development of e-supplements on the Structure and Function of Biomolecules of amino acids from tampoi fruit, such as the addition of information delivery in the form of audio, graphics, animation, or video. In addition, further research is needed to find out how effective and efficient the use of this e-supplement is in learning Biomolecular Structure and Function courses.

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