Development of e-Modules Based Case Study on the Nervous System Materials for Students

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Abstract: The nervous system is a complex biological because the material is still abstract. The method used by teachers is the lecture method which causes students to have difficulty in understanding the material. To overcome this, a case study-based e-Module is needed that can provide students with cases related to the material and be a solution to students' difficulties related to minimal learning in class. This study aims to develop a case study-based e-Module on the nervous system material and analyze the feasibility of the developed product. This study uses the ADDIE development model consisting of Analyze, Design, Develop, Implement and Evaluation. The results of the study showed that the developed e-Module obtained a percentage of 91.66% with the category "very feasible" in the material validation. At the media validation stage, a percentage value of 94.11% was obtained with the category "very feasible". The biology teacher's perception of the quality of the developed product obtained a percentage of 91.17% with the category "very good". Small group trials with students obtained a percentage of 95.20% with the category "very good" and large group trials obtained a percentage of 94.68% with the category "very good". Thus, it can be concluded that the product developed is feasible and practical and received by teachers and students as a learning tool that supports students' learning process on the nervous system material.

Keywords: Case study; e-Module; Heyzine; Nervous system

Introduction

The material on the nervous system is included in one of the subtopics in the discussion of the coordination system studied in the even semester of class XI MIPA. The discussion of the coordination system includes how nerves, sensory organs, hormones, the impact of psychotropic use, and disorders that occur in this system. The nervous system plays a role in regulating the body's response to stimuli from the external and internal environment (Ayundari & Manalu, 2024). The nervous system material is often considered difficult to understand by students. This difficulty is caused by the nature of the material which tends to be abstract and difficult to observe directly, so it requires additional

media or teaching materials in the learning process (Nurdiani et al., 2024).

However, in reality there are still some problems in learning the nervous system because the complexity and abstractness of the nervous system include discussions of internal organs, organ systems, ion exchange, impulse mechanisms in nerve cells, reciprocal interactions of nerve cell responses, and special functions that are not visible to the naked eye. This makes the learning process challenging and prone to misconceptions (Ratnasari et al., 2023). Although this material is actually very relevant to everyday life, teachers often only convey the contents of the book without linking it to the real context. As a result, students feel that the nervous system material has no practical benefits, which then makes

learning feel monotonous and boring. One of the biology topics that students find challenging to grasp is the nervous system, as it is highly complex and abstract in nature (Rohmah & Anggraito, 2021).

Based on the results of observations that have been carried out at Tanjung Jabung Barat 2 High School which were carried out on October 31, 2022, it shows that the learning process is still less than optimal because students tend to only take notes and listen to the teacher's explanation, so that the quality of the learning process decreases which results in student enthusiasm in Biology subjects, especially nervous system material. The decline in the quality of the learning process can be seen from various problems that occur in the classroom. The problems that occur in the learning process based on interviews with Biology subject teachers are the lack of teaching materials used because the teaching materials are only in the form of printed books that are less interesting for students.

According to the findings of study interviews with biology teachers at Tanjung Jabung Barat 2 High School, it shows that nervous system in biology subject matter is difficult for students to understand due to several factors such as complex material and is considered by students as a memorization lesson according to previous studies (Fauzi & Mitalistiani, 2018; Husna et al., 2023; Yusipa, 2024). In addition, there are foreign terms or Latin names that are also difficult to understand. Many students do not understand the nervous system material which causes problems related to student motivation, innovation is needed that can motivate students to continue learning, make students understand by linking nervous system material and real cases in everyday life, namely by developing teaching materials that can facilitate understanding and motivate students, namely integrating e-Modules with case study.

Therefore, a solution is needed to overcome these problems. One of the learning methods that involves students in learning activities is the case study method. The case study method encourages active student involvement in learning so that students do not get bored (Nugroho & Bramasta, 2019). Case study learning helps students to formulate problems, test their own opinions, and be aware of their abilities. Presentation of material using learning media as additional teaching materials for teachers can foster students' curiosity and stimulate students to act physically and emotionally (Anggraeni et al., 2023). One of the learning media that can be used in learning activities is e-Modules. The use of interesting e-Modules learning media can foster students' curiosity to learn.

One way to overcome students' difficulties in learning the nervous system material is through the use of learning media in the learning process. E-Modules are one alternative as additional teaching materials in the

learning process that are right for students to make it easier for them to learn abstract lesson materials (Mispandi & Fahrurrozi, 2022; Fadha et al., 2023; Saryadi & Sulisworo, 2023; Dewi et al., 2024). The advantages of e-Modules based on case studies are that they are interactive so that they can make students interested in adding information about the concepts to be studied. The case study method is packaged in an interesting and creative way so that it can help students understand a material and make students better and also the material delivered by the teacher is not hampered.

The advantages of this case study method itself are that students are challenged to analyze problems presented in the form of cases, draw conclusions based on limited information, make decisions on uncertain, ambiguous, and conflicting issues that simulate the real world (Egonsdotter & Bengtsson, 2023). Therefore, case studies focus students on real-world situations, cases, or examples when they need to take action and identify the benefits they can learn. The cases raised in this teaching material are cases of disorders and abnormalities of the nervous system. This is also evidenced by the results of research conducted by Syahroni & Firmadani (2022), that case study-based modules in the learning process of the teaching profession so that students can be motivated to study the material independently.

On the other hand, the existence of case study-based modules as additional learning resources in the nervous system material has not yet developed e-Modules based on case studies on the nervous system material in schools. The existence of modules can help teachers optimize the implementation of learning as additional teaching materials. Case studies in the proof of Mentari & Laily (2016) also showed positive results of e-Modules as additional teaching materials on students' motivation and learning quality because case study-based learning designs can make students better understand the material and master learning according to the semester learning plan that has been prepared. In addition, students will be more responsible for the problems given to be resolved immediately. Therefore, the case study method is very effective in learning and can be integrated into teaching materials.

From the explanation above it is known that case studies are recommended for teachers to apply case study-based learning methods in the classroom in order to meet the desired indicator achievements. Based on these problems, the research will develop a product in the form of an e-Module based case study as additional teaching materials for teachers using the ADDIE development model and analyzing the feasibility of developing e-Module e on the nervous system material. There are several differences from previous studies, the first difference lies in the level of school in the study, in this study it will be intended for high school students,

namely in the science material regarding the nervous system of grade IX. This study will also be intended for high school students, namely in the science material on the nervous system of class IX, this theme was chosen because the material is considered difficult to understand if it does not use the help of learning media. The nervous system is closely related to the human body, the system in the human body that cannot be seen directly by humans themselves so that the media is formed so that students know the mechanism of the system in the human body more interestingly and easily understood, this study also uses a case study method by combining several studies, namely the nervous system.

Method

This research is a qualitative and quantitative research uses a Research and Development (R&D) approach, which is a development research method used to produce new products and test them to evaluate their effectiveness (Astuti & Louise, 2024). The R&D approach was applied with the aim of developing and validating Case Study-based teaching materials on the Nervous System material for grade XI high school students. The location of the research was carried out at SMA Negeri 2 Tanjung Jabung Barat in the even semester of the 2022/2023 academic year, with the location selection using the simple random sampling method. The data obtained will later be used to improve and perfect the case study-based e-Modules on the nervous system material which is the product that will be produced in this research. Determination of research subjects was carried out using a simple random sampling technique. Small group trials were 6 students and 20 students for large group trials.

In this development, the research refers to the Branch development model known as the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) development. The development stages consist of the analysis stage, design stage, development stage, implementation stage, and evaluation stage which are always present in every ADDIE stage in Figure 1, Figure 2, Figure 3, and Figure 4.

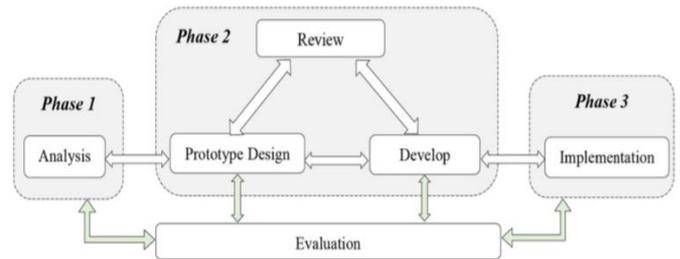**Figure 1.** Development model ADDIE (Branch, 2009)

Figure 2. Proposed instructional design with ADDIE (Shakeel et al., 2023)

In this development research, the types of data obtained are qualitative and quantitative (Ly et al., 2024). Qualitative data were obtained from a team of experts and students as respondents who provided responses and suggestions from respondents and validators regarding the feasibility of the e-Module. While quantitative data were obtained from the calculation of the results of the trial questionnaire, expert validators, both media experts and material experts. Data collection in this research used instruments in the form of questionnaires and interviews. The questionnaire in this development research was used to obtain data from media experts and material experts as well as students as evaluation materials for the learning media being developed. The questionnaire used in this study was a closed questionnaire, so that respondents only chose the answers that had been provided.

The product uses a Likert scale for measurement scale for validation questionnaires and product trials with an interval of 1 to 4 (Setiyaningsih et al., 2024). Through the provision of an assessment questionnaires to examine the product's suitability, material and media experts conduct validation.
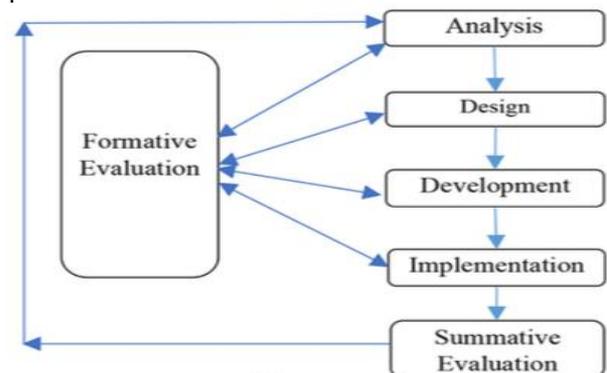

Figure 3. ADDIE adapted from Kulvietiene & Sileikiene (Shakeel et al., 2023)
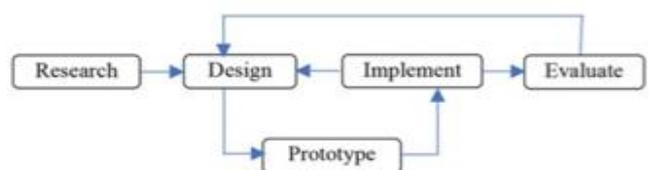

Figure 4. Rapid Prototyping (RP) adapted from Meier and Miller (Shakeel et al., 2023)

Result and Discussion

Development of e-Modules based on case study on the nervous system implemented by the ADDIE development stages, which consist of 5 stages, namely analysis, design, development, implementation, evaluation, where this is in accordance with earlier researches (Sriwahyuni et al., 2021; Faghihi et al., 2023; Tiwow & Sugiarto, 2024; Song & Sabran, 2024; Dilaines et al., 2024).

Analysis Stage

The stages of analysis carried out by the researcher are: needs analysis, material analysis, and educational technology analysis. The analysis stage was conducted by interviewing biology teachers and distributing questionnaires to class XI IPA students. Based on the results of interviews with biology teachers at Tanjung Jabung Barat 2 High School, it is known that teachers and students need interesting and easily accessible teaching materials. The biology teacher for class XI at Tanjung Jabung Barat 2 High School stated that one of the materials that is difficult to understand is the nervous system material.

Biology teachers at Tanjung Jabung Barat 2 High School also really need media that can help the teaching and learning process so that they can overcome student boredom in learning. Due to the limited knowledge of teachers in developing learning media, more varied learning media such as e-Modules have been developed. The use of electronic media in the form of smartphones has also been given freedom to students in learning biology. This means that students are allowed to use laptops and smartphones. Since the case study-based e-Modules developed by researchers can only be used on smartphones and laptops, e-Modules can be utilized by students and teachers at school.

Based on the results of the material analysis, the nervous system material at Tanjung Jabung Barat 2 High School is divided into 5 topics of Nervous System Components and Nerve Impulse Performance Mechanisms, Central Nervous System, Peripheral Nervous System, Disorders and Abnormalities in the Nervous System, and Neurotechnology. Table 1 shows the percentage of completion of Biology learning outcomes for second semester students in class XI IPA Tanjung Jabung Barat 2 High School.

Table 1. Percentage of Biology learning outcomes completion in class XI IPA SMAN 2 Tanjung Jabung Barat on the Nervous System material

Class	Number of Students	Complete (%)	Incomplete (%)
A (IPA 1)	26	70.5	29.5
B (IPA 2)	31	50.4	49.6
C (IPA 3)	28	48.8	52.2

The nervous system material is still considered difficult by students because of its complexity, making it difficult to learn. Therefore, researchers further developed e-Module teaching materials based on case studies on the nervous system material to be used as additional teaching materials by teachers and to help students understand the nervous system materials.

Educational technology analysis was conducted to determine whether the place that will be used as a research site can support the implementation of the research. It is known that Tanjung Jabung Barat 2 High School already has sufficient facilities in the form of computers, projectors and Wi-Fi. Students also have smartphones. Additional teaching materials that are usually used at Tanjung Jabung Barat 2 High School in biology learning are limited to video learning, Power Point presentations, or printed modules that have more or less the same content as the main printed books. The printed books used in schools are limited in number because the school library only provides 40 printed books while the number of students is 85 in class XI IPA.

In addition to the limited number, access to borrow books is also difficult because books are only used when biology learning is taking place in class. The contents of the printed books used contain too much text so that students' understanding of these abstract concepts is not optimal, while Tanjung Jabung Barat 2 High School still has too few learning support tools for the nervous system material. Another learning resource related to the nervous system material is student worksheets (LKS). Teachers also rarely use other learning media. This is because teachers rely on using media in the form of PowerPoint presentations displayed with a projector. Teachers have also not used quite varied learning media.

Based on research by Sitorus & Santoso (2022) stated that teachers must make variations in using students' technology to increase students' attention and motivation in learning and eliminate' boredom and saturation in receiving teaching materials provided by teachers. Nervous system material really needs clear and attractive images, as well as videos with very detailed explanations. So, the teaching materials developed in the form of electronic modules have clear and attractive images and videos with easy-to-understand explanations so that students find it easier to understand the material. The modules can also be accessed via smartphones, laptops, and computers. In addition, this e-Module is also practical and efficient because it can be accessed anywhere using the internet.

Design Stage

The next step after the analysis is done is product design. In product design by holding or making what is needed, compiling implementation or development objectives, and producing a testing strategy from a

product design which will then be used as a teaching material in the form of an e-Module product based on case studies using Heyzine and Canva software on the nervous system material. At this stage, several stages are carried out including team formation, research schedule, media specifications, material structure, flowchart design and storyboard.

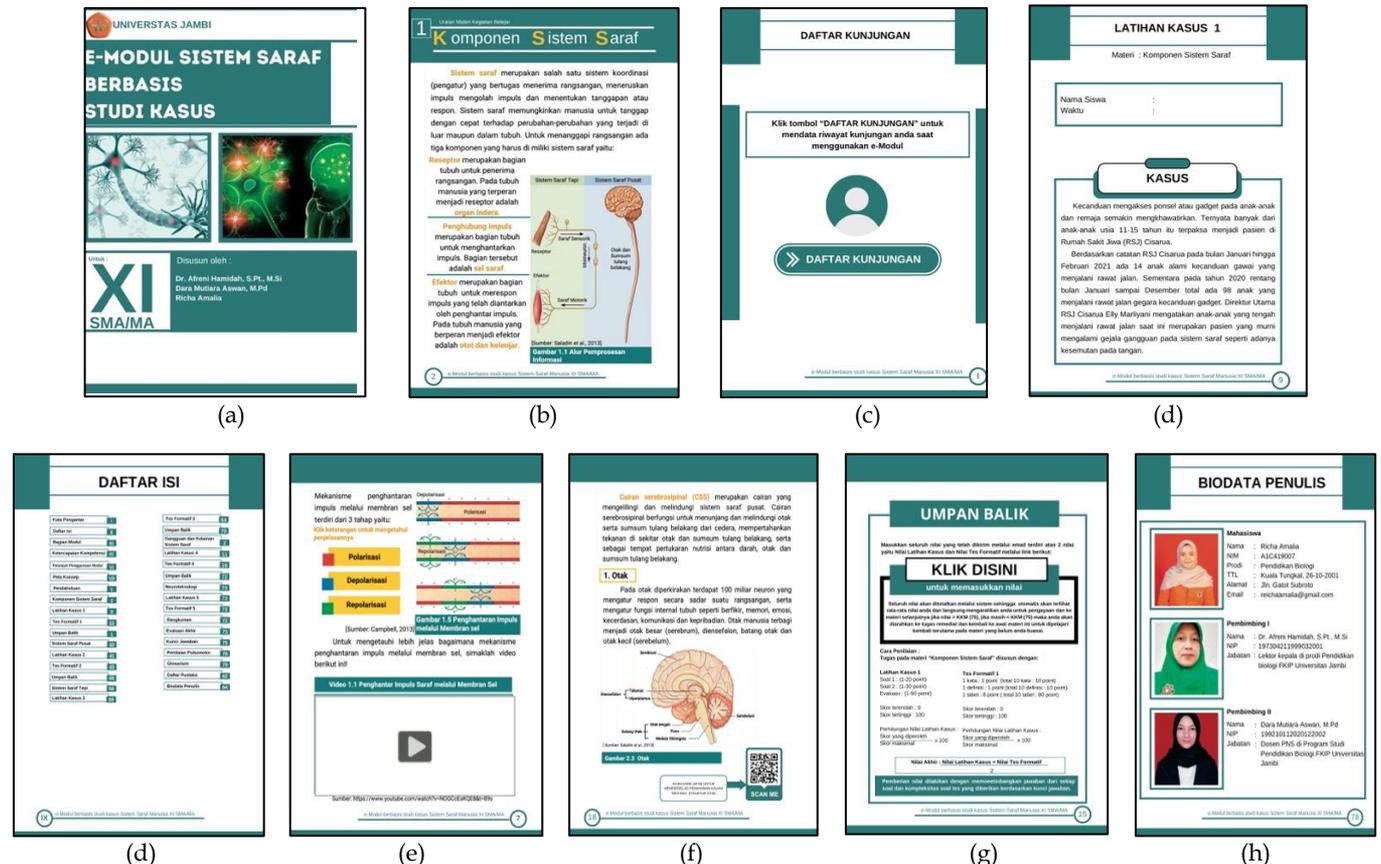The following is the results design of the e-Module cover which can be seen in Figure 5.

Figure 5. Display of e-module based case study: (a) front cover; (b) material of nervous system; (c) visit list; (d) case study sheet; (e) list of contents; (f) video youtube in material; (g) automatic feedback; (h) QR-Code in material; (i) author biodata

To produce a good e-Module, the following criteria must be considered: self-instruction, self-contained, stand alone, adaptive, and user friendly or easy to use in accordance with previous research (Hasan et al., 2018; Johan et al., 2022; Hadira et al., 2024). The design stage is carried out to design the content and form of the e-Module of the human nervous system material for class XI SMA. The main specifications of this e-Module teaching material are that it has a display based on case studies and can be accessed online via a website link.

Development Stage

At this development stage, it is the product realization stage to realize the development plan that has been made in the design stage into a real form. The development stage is conducted in accordance with previous research (Yulanda et al., 2023; Saputra et al., 2024; Meydi et al., 2024). The results at this development stage are to produce an e-Modules product that has been structured according to the applicable competencies and a questionnaire to measure the validity of the learning resources that have been selected and the responses of the research subjects.

After e-Modules based on cased study has been designed, validation is carried out. Validation is carried out by material experts and media experts to evaluate the feasibility of the product before testing with the aim of assessing the feasibility of the product before being tested on students. The data collection technique is carried out by giving a set of questions or written questions to respondents to answer.

The questionnaire is used to obtain qualitative data in the form of suggestions for improving the media and quantitative data on the feasibility of the media. Suggestions for improving the media are obtained from a team of experts (validation stage), namely media experts and material experts, then the learning media is also revised and assessed by the teacher and after that, the media can be tested on students. The assessment of the learning media by the teacher aims to determine

whether the case study-based e-Modules that has been developed can be used or not. The results obtained are shown in Table 2-5.

Table 2. Material validation results

Indicator	Validation Result (%)		
	1	2	3
Content	50	67.85	85.71
Language	57.14	60.71	93.28
Construction	50	75	100
Average (%)	52.77	70.83	91.66
Category	Not Feasible	Feasible	Very Feasible

Table 3. Media validation results

Indicator	Validation Result (%)	
	1	2
Learning	50	91.66
Display	45	95
Writing	60	90
e-Module section completeness	63.09	97.61
Average (%)	55.88	94.11
Category	Not Feasible	Very Feasible

Table 4. Biology teacher assessment results

Indicator	Validation Result (%)
Teacher Perception	93.75
Material	92.85
Operation of Media	87.5
Average (%)	91.17
Category	Very Good

Table 5. Students trial assessment results

Indicator	Validation Result (%)	
	Small Groups	Big Groups
Students' Perception	100	99.10
Material	94.04	90.53
Operation of Media	87.5	94.37
Average (%)	95.20	94.68
Category	Very Good	Very Good

Implementation Stage

The implementation stage is not carried out because the limited to the product development stage to analyze the feasibility of the media being developed with the data obtained at this stage used to refine the product being developed, in accordance with the previous research (Ahmed & Kumalasari, 2023; Chusna et al., 2024).

The researcher introduced the e-Module to the students, then the students tried to study and fill in the practice questions contained in the e-Module because limited manner so that it can only be tested on class XI IPA students of Tanjung Jabung Barat 2 High School who have studied the nervous system material and to find out whether the e-Module developed is suitable for use in the learning process. The e-Modules has a history of visits to the e-Modules from 46 users with 35 users liking the e-Modules and 11 other users not as a result of the trial to students for the implementation stage.

After the e-Modules is accessed, at the end of the e-Module the user is required to provide comments in order to improve the product being developed. The following are responses from users for the improvement product (Table 6).

Table 6. e-Module users' response of the e-Modules

User Response in Terms of Appearance, Content, and Access		User Response in Terms of Usefulness		User Response Provide Suggestions and Input	
Respondents Initials	Comments	Respondents Initials	Comments	Respondents Initials	Comments
AA	The e-Module is very good, creative, varied, and has many interesting videos and images, the e-Module is not boring for independent learning at home, the learning videos are very good, the information obtained is much from bio facts and donkey bridges, the material is easy to understand and clear, the e-Module is quite practical to access, easy to use, and has complete features.	JCS	The media is very interactive, provides students with learning motivation, increases their insight into the nervous system, is effective for use in biology learning, and increases knowledge through the case studies presented.	ERL	Improve network access on e-Modules, colors on e-Modules be more explained, values on e-Modules should be sent directly after filling in answers, access should be direct without email.
ASN		PR		TAF	
ANA		RD		SH	
CA		RMP			
DAP		JS			
FF		RF			
FTS		RM			
HDS		RAR			
NA		MYP			
SW		SS			
SBA		MK			
MT		MMS			

Evaluation Stage

The evaluation stage used is formative evaluation, formative evaluation is carried out starting from media validation, material validation, teacher assessment and

research product trials to small and large groups of students. After carrying out the material and media validation stage until the product can be declared feasible to be tested in the field, it is then continued with

an assessment by the biology subject teacher in order to find out that the product is good to be tested on students. After that, it is continued with small and large group trials to see the feasibility of the e-Modules product based on case studies on the nervous system material.

The evaluation stage carried out is a formative evaluation. According to Kaniawati et al. (2023) in general, formative evaluation is an evaluation carried out after a set of lesson programs have been completed after all lesson units have been taught. The main purpose of this formative evaluation is to determine the success of the learning media development stages after they have completed all the ADDIE stages carried out within a predetermined period of time. Based on the results of the evaluation of the ADDIE stages that have been carried out, it is known that all stages have been carried out in accordance with the research method. Every suggestion and input from the validator, biology subject teacher and class XI students of Tanjung Jabung Barat 2 High School is considered and carried out so that the learning media developed is suitable for use in the learning process. The e-Modules teaching material based on case studies on nervous system material was developed using the ADDIE stages. This development stage consists of several stages, namely analysis, design, development, implementation, and evaluation.

The first stage of ADDIE to be evaluated is the analysis stage, which consists of analysis of student and teacher needs, analysis of objectives, analysis of materials, and analysis of media. This analysis aims to determine the conditions and needs of students who will be the target users of the product to be developed. Referring to the results of observations regarding the analysis of student needs to be conducted at Tanjung Jabung Barat 2 High School, the results were obtained in the form of several problems and obstacles in the learning process, namely that the school still applies an instructional learning system that emphasizes intellectual skills consisting of concepts, rules, and procedures to solve a problem.

Learning in the classroom is still teacher-directed, so that the learning process becomes less effective which states that if the foundation in a learning system is weak, then learning activities will not run effectively in accordance with previous research (Akhwani & Nurizka, 2021; Morris et al., 2023). Based on the results of interviews conducted with biology subject teachers of class XI Tanjung Jabung Barat 2 High School, it is known that students are less active in the learning process. Student inactivity occurs due to minimal students' participation in class, either in asking questions, discussing or answering questions. On average, in a class of 28 to 30 students, only 4 to 5 students are active, while the rest are passive, namely collecting assignments and listening to lectures from the teacher.

Another problem is the low quality of the learning process that occurs. This is indicated by students' lack of readiness when learning begins in class, students' dependence on teacher's lectures, low quantity and quality of student questions. Every time the teacher finishes explaining one topic, a maximum of only 1-2 students provides feedback, and it often happens in certain classes that no one asks questions at all. In line with the research conducted by Febriyana et al. (2023) stated that students become less active in learning activities because students always depend on teachers, so that students become less active in learning activities and students do not carry out learning activities in real conditions related to the theories they have previously studied.

In the analysis of the material that has been carried out, it is known that students have difficulty learning the nervous system material because the material is quite complex. In addition, students need to study nervous system equipment that is connected to related cases. One thing that students need to know today is the nervous system material neurotechnology. This is because neurotechnology is a technology that is used to see the interaction of how the nervous system works. The need for additional materials in learning materials in schools related to neurotechnology. The difficulty of students understanding nervous system materials is not only because the material is complex and quite a lot, but the learning process that only uses printed books is one of the causes. Therefore, it is necessary to have additional teaching materials that support the learning process so that students can more easily understand the material being studied. Therefore, researchers developed e-Modules based on case studies on the nervous system to help the teaching and learning process. Referring to the stage of educational technology analysis carried out at Tanjung Jabung Barat 2 High School. It is known that the technology used by students and teachers is smartphones, laptops, computers, and LCD projectors. So that the teaching materials that researchers develop in the form of e-Modules based on case studies can be accessed by students and teachers because they already have good features.

Next is the design stage, which is the process of designing the product to be made. This stage begins with the creation of a flowchart and storyboard. Then designed using Heyzine and Canva software. Furthermore, it is developed in the development stage. At this stage, it was carried out with a feasibility test of materials and media experts. There are several comments, suggestions and input from the expert team which will later be used as a reference for improving the product being developed until the product is declared suitable for testing in the field. Validation of learning

media products is carried out three times each, namely material validation and media validation.

Initial revisions based on the material validator's suggestions were made to minimize the weaknesses of the case study-based e-Module. This evaluation stage was carried out based on the suggestions given by the material validator. The evaluation carried out concerned the material in the e-Module based case study. Revisions based on media validator suggestions were made to minimize the weaknesses of the e-Modules based on case study. This evaluation stage was carried out based on suggestions given by the media validator. The evaluation carried out concerned the operation of the e-Module based case study media. The following is the media and material validator evaluation in Table 7 and 8.

Table 7. Material validator revisions and suggestions

Validation to -	Suggestions from Validator	Information
Validation of Material 1	On the cover, add the biology education logo of the University of Jambi, then replace the animated nerve image with a real nerve image, and minimize the cover components.	Has been fixed
	In the foreword section, the words are corrected, only the unnecessary ones are deleted.	
	The instructions for use must be differentiated between students and teachers, if possible, made into two modules, one for students and one for teachers.	
	In the case study section, the description of the material is shortened.	
Validation of Material 2	In the case study questions, the writing style of each question has been further improved.	Has been fixed
	Neurotechnology material was added to the material.	
	The image title is placed below the image.	
	In the e-Module feedback, a method should be provided so that students cannot go directly to the next learning activity if they have not met the KKM.	
	Create a module for teachers to use.	
Validation of Material 3	Module Parts changed to Module Components.	Has been fixed
	Just the basics of the table of contents.	

Table 8. Media validator revisions and suggestions

Validation to -	Suggestions from Validator	Information
Validation of Material 1	At the beginning of the e-Module, a visit history was added to find out access from e-Module users.	Has been fixed
	Add pop up images to each learning activity to make it more interactive.	
	In the e-Module, access has been added for comments from students as input to build the e-Module in the future.	
	In bio facts it is better to add a link.	
Validation of Material 2	The Answer Key should be locked so that it cannot be accessed by students.	Has been fixed

Based on the results of the material validation in the first stage, the percentage of product quality was 52.77%, so improvements were made based on suggestions and input from material experts on the contents of the e-Module material that were not yet feasible. Furthermore, the second validation stage was carried out and the percentage of product quality was 70.83%. Based on suggestions and input from material experts, the product still needs improvement and the addition of more complete material. After improvements were made, the product was validated for its feasibility and received a product quality percentage of 91.66% and was categorized as feasible for testing without revision.

Based on the three stages of product feasibility validation, it was concluded that at each stage of material validation there was an increase in improvement and quality. So that the product is worthy of being tested in the field. Referring to the results of the material validation, it is known that the e-Modules product based on case studies on the nervous system material was developed to be worthy of being tested because it has a good explanation starting from text, images, videos, QR-Code and other interactive components. This is because the e-Module is designed as well as possible so that the material contained in the media is easy for students to understand.

Figure 6. (a) before; (b) after revision of worksheets into case studies; (c) before; (d) after revision of image display; (e) before; (f) after revision of feedback display

Based on the results of media expert validation, it was found that in the first stage of validation, the percentage of product feasibility was 55.88% so that improvements were made based on suggestions and comments from media experts on improving features in the e-Modules that were still confusing. After improvements were made, the product was validated in the second stage and obtained a product quality percentage of 94.11% and was worthy of being tested in the field. Based on the analysis of the two stages of product feasibility validation, it was concluded that at each stage of media validation, there was an increase in improvement and good quality. So that the product is worth being tested in the field. Based on the results of material validation and media validation, it can be concluded that the e-Modules based on case studies on the material of the nervous system of class XI SMA is worthy of being assessed by the perceptions of subject teachers and students at Tanjung Jabung Barat 2 High School. After the product was validated by the validator team, the product was then tested in the field to determine and analyze the perception assessment of biology subject teachers and class XI students of Tanjung Jabung Barat 2 High School. The stages of student perception assessment were carried out in two stages, namely small group assessment and large group assessment. This trial was carried out by distributing questionnaire sheets in class.

Based on the trial results, it is known that the e-Modules based on case study is suitable for use as teaching materials for teachers and students. The results of the teacher perception questionnaire on the product obtained a feasibility percentage of 91.17% and are included in the "Very Good" category. The results of the small group students' perception questionnaire on the product obtained a percentage of 95.20% and are included in the "Very Good" category. The results of the large group students' perception questionnaire on the product obtained a percentage of 94.68% and are included in the "Very Good" category.

Based on the results of the perception, it can be concluded that the e-Modules based on case studies on the material of the nervous system of class XI SMA is worthy, being used as an additional teaching material because it is very interesting for students learning the nervous system material. Based on Ly et al. (2024) which

reveals that case study-based e-Modules can be additional teaching materials for biology concepts because e-Modules are interesting and practical to use in learning.

The implementation stage it was not carried out to determine the feasibility of the media developed by the researcher while the data obtained at this stage is used to refine the product being developed. This stage is carried out, but only up to the process of introducing the e-Modules to students due to time constraints and the nervous system material included in the coordination system material section has been studied at school. Comments and suggestions given by students for the e-Modules as a whole are that the media display is very attractive, learning becomes fun, the material is easy to understand, and is useful for teaching material about the nervous system, but the drawback is that the internet network must be stable to access the e-Modules media, the suggestion is that it is better to use offline software.

Based on the results of the teacher assessment questionnaire and student responses, it can be concluded that the e-Module based on case study products can be used as additional teaching materials, because it can be teaching materials about the nervous system. This is in accordance with research conducted by Puspitasari (2019). e-Module can be additional teaching materials in helping students understand lessons.

However, e-Modules can also be accesses without being connected to the internet network if they have been downloaded. This can certainly facilitate students and teachers in the learning process. Puspitasari (2019) states that through e-Modules, someone can learn independently and actively in ongoing learning activities and learning using teaching materials has optimized the role of teachers as motivators. Interesting things can also be seen from the advantages of using e-Modules according to Firdaus & Pahlevi (2022) who state that e-Modules are teaching materials that have better effectiveness than printed modules.

In the development of e-Modules combined with case studies as a learning method, it can help students in learning. This is because the case study method in the e-Modules can develop students' understanding of the nervous system material. Case-based learning provides opportunities for students to develop their potential, actualize themselves, innovate, and find solutions to the cases presented so that students can focus on achieving superior achievements in developing their potential. In accordance with the opinion of Fitri & Patriana (2022) that through the case study method, students are able to link phenomena or cases that often occur in their environment with the theories studied.

This process can be carried out through individual learning or large or small groups. Students are faced with various problems and must find solutions based on the theories studied which ultimately learning objectives can be achieved effectively. Relevant research that proves that e-Modules based on case study are effective for use in the learning process is research conducted by Kusumantoro et al. (2022) that e-Modules based on case study are suitable for use in learning because they stimulate students to actively independently study the concept of the material that is the core of learning with the ideal case study sequence, namely determining the case, analyzing the case, collecting information and determining the steps for resolution, formulating conclusions, agreeing on a conclusion for the case given. The evaluation stage carried out is a formative evaluation.

According to Kaniawati et al. (2023) formative evaluation is an evaluation carried out after a set of lesson programs have been completed after all lesson units have been taught. The main purpose of this formative evaluation is to determine the success of the learning media development stage after they have completed all the ADDIE stages which are carried out within a predetermined time period. Based on the evaluation results of the ADDIE stages that have been carried out, it is known that all stages have been carried out in accordance with the research method. Every suggestion and input from the validator, biology subject teacher and class XI students of Tanjung Jabung Barat 2 High School were considered and carried out so that the learning media developed were suitable for use in the learning process.

The advantages of e-Modules based on case study on the nervous system material for grade XI SMA are as follows: the material presented in the e-Modules includes the nervous system consisting of components of the nervous system, central nervous system, peripheral nervous system, disorders and disorders of the nervous system and neurotechnology. E-Modules can be used as additional teaching materials for learning for students and teachers. Case studies in e-Modules are presented with cases that bring students closer to the problems they face every day. So that the knowledge they have is very related and meaningful in-depth for students' learning experiences.

Case studies presented in e-Modules enable students to analyze cases that occur in their surroundings and then connect them with the theories they have learned. E-Modules are equipped with a list of visits, foreword, table of contents, KI, KD, learning objectives, introduction, materials, images, videos, QR Code, mnemonic bridge, bio facts, case studies, formative tests, feedback, summary, final evaluation, assessment, answer key, glossary, bibliography and author biodata as well as interactive features that can make students more interested in using e-Modules as

learning resources. Media can be accessed through various smart devices such as smartphones, laptops and computers. E-Modules are arranged systematically so that they can stimulate students to actively independently study the concept of the material that is the core of learning because there are interactive features and concise explanations.

Conclusion

E-Modules based on case studies on the nervous system material were developed using the ADDIE development model. The e-Module was declared suitable for testing. The feasibility of the media developed based on the assessment results by the validator material with a percentage of 91.66% with the category "Very Feasible", and the assessment results by the media validator obtained a percentage result of 94.11% with the category "Very Feasible". The perception of biology subject teachers towards the development of e-Modules based on case studies on the nervous system material obtained a percentage result of 91.17% with the category "Very Good", so it can be said that the e-Modules were well received by teachers and can be used in learning. Next, product trials for implementation stage were carried out in biology teacher and class XI science students at Tanjung Jabung Barat 2 High School, consisting 6 small group students and 20 large group students. The assessment of biology teacher' perceptions of the developed e-Module obtained a percentage of 91,17% in the "Very Good" category, so that it can be well received by teacher and can be used for learning biology especially nervous system materials. Furthermore, the assessment of students' perceptions of the development of e-Modules based on case study on the nervous system material obtained a percentage for the small group of 95.20% with the category "Very Good" and the percentage obtained in the large group was 94.68% with the category "Very Good". So, it can be said that the developed product was well received by students as a learning tool that supports students' learning process on the nervous system material.

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