



Development of E-Handouts as Teaching Materials for the Sub-Concept of the Human Sensory System in Senior High School

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DOI: <http://dx.doi.org/10.18592/tarbiyah.v13i2.14009>

Key Words:

e-handouts
human sensory system
teaching materials

Received : 21 September 2024
Revised : 26 September 2024
Accepted : 12 December 2024
Published : 25 December 2024

Abstract:

This study aims to describe the validity, readability, and student responses regarding the e-handout on the sub-concept of the human sensory system for 11th grade at SMA/MA. This type of research is a research and development study using the ADDIE model. The research is limited to the Development stage. Data analysis techniques are obtained through validity, readability, and student response tests. The results of the research were developed into an E-Handout. Based on the validity test results, the suitability achieved a percentage of 85,81% (very valid), and the feasibility validation received 87,11% (very valid). The readability test received a percentage of 88,68% (perfect). The student response test obtained a percentage of 89,15% (very good). This research highlights the importance of integrating technology into education and supporting the development of digital competencies among students relevant to the times' demands. The e-handout can enhance students' interest and engagement in learning, given the use of interactive and easily accessible digital learning materials. The conclusion is that the developed E-Handout has several unique characteristics, making it an engaging learning resource. These include a systematic presentation of material supported by clear images and illustrations.

To cite this article: Wasilah, E.S., Kaspul, Ajizah, A. (2024). Development of E-Handouts as Teaching Materials for the Sub-Concept of the Human Sensory System in Senior High School. *Tarbiyah: Jurnal Ilmiah Kependidikan*. Vol 13 (2), 259-271.

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Introduction

The importance of education as a fundamental human need cannot be denied, as education plays a vital role in preparing individuals to contribute to the progress and advancement of their nation and society. The rapid development of science and technology has brought about complex and diverse changes (Hidayat & Abdillah, 2019; Ayu & Rahma Amelia, 2020; Widiastini, 2021). Acknowledging this, the Indonesian Ministry of Education and Culture has designed a 21st-century learning paradigm emphasising students' capacity to acquire knowledge from various sources, formulate problems, engage in analytical thinking, and collaborate effectively to solve challenges (Daryanto, 2017; Sarifah, 2022).

The independent curriculum also provides more freedom of movement for teachers, students, and schools. The independent curriculum hopes that learning can help students grow into Pancasila learners and be prepared to face the future. The independent learning policy is a change towards success in Education (Lestari et al., 2023; Daga, 2021). A handout is one of the learning materials that is complete according to the current independent curriculum module. The handout is used as a learning media for student learning resources in the learning process. Handouts are classified as written teaching materials that contain important descriptions of learning material. The handouts provided can also help students learn in a directed manner. This will increase student activity during lessons, making it easier for teachers to teach (Laela & Rinaningsih, 2021; Rustamana et al., 2023; Sarita et al., 2021).

The developed handout also adapts to technological developments, namely Electronic Handouts. Electronic teaching materials are teaching materials whose content is packaged in electronic form; these can be interactive media, audio, or video. Some teaching materials included in e-textbooks include books such as e-books, e-magazines or simply e-magazines, interactive multimedia CD/DVDs, Flash models or interactive slides, e-learning, and others (Sriwahyuni et al., 2019 in Ramadhana et al., 2022; Daryanto, 2014; Azman et al., 2022).

The use of E-Handout teaching materials greatly supports learning about the human sensory system. The presence of handouts as study guides can develop skills and make students more active. According to Riefani (2019), the presentation of comprehensive images and information in teaching materials can be used to train thinking skills, develop imagination, represent real-life situations, demonstrate differences and similarities, and make the data collection process more efficient (Nugraha et al., 2020).

Based on a needs assessment questionnaire given to teachers who teach biology at SMAN 1 Alalak, SMAN 1 Gambut, and SMA-IT Qardhan Hasana shows that the learning media used by teachers in their lessons entirely relies on PowerPoint. Teaching materials beyond textbooks received positive responses from enthusiastic, interested, and active students during the learning process. The sub-concept material of the human sensory system is less appealing to students, indicating the need for teaching materials that are complemented with images and videos.

According to the results of a needs assessment questionnaire given to students at SMAN 1 Alalak, SMAN 1 Gambut, and SMA-IT Qardhan Hasana who have studied the Human Sensory System material, they stated that the learning resources used in class are primarily textbooks. Handouts are still minimal, and E-bandouts have never

been used; instead, textbooks are predominantly utilized in biology lessons. Students need help understanding the Human Sensory System material due to the complex language used in teaching materials and a lack of photos/images related to the learning topic.

Handouts containing material about the human sensory system would be interesting to develop using Heyzine. Teaching materials can assist students in learning and serve as reference materials for educators to provide learning resources. Students can also showcase their skills during their studies and improve their academic results. Handouts function as aids that present information about the characteristics of the human sensory system in a structured manner. This helps students better understand the functions and mechanisms of sensory organs.

Based on the above description, developing E-Handouts for the sub-concept of the Human Sensory System for Class XI in SMA/MA is necessary to support biology lessons. Therefore, E-Handouts are needed as teaching materials so students will be more motivated to learn, resulting in improved learning outcomes. This aims to develop more engaging E-Handouts and enhance effective learning processes. The teaching and learning process is crucial in improving students' knowledge, attitudes, and skills. Students often feel bored due to a lack of supporting images and monotonous teaching styles.

Research Method

The method used in this research is research and development employing the ADDIE model. This research and development process has five stages: Analysis, Design, Development, Implementation, and Evaluation. However, this study's stages are limited to three: Analysis, Design, and Development. This research was conducted from February to May 2024 at SMAN 1 Alalak.

The subjects for validation in the Development stage consist of two lecturers from the Human Anatomy and Physiology course in the Biology Education Study Program at FKIP ULM Banjarmasin and one partner teacher of Biology for Class XI at SMAN 1 Alalak.

The validity assessment table contained data on the validity of the E-Handout teaching materials. The technique for analyzing the validity of the data involves assigning scores of one (very valid), two (valid), three (less valid), and four (not valid). After validators have evaluated the data, improvements will be made based on their feedback and suggestions.

The technique for analyzing validity data uses the formula from Akbar (2017), which can be found in Formula (1).

$$Va = \frac{TSe}{TSh} \times 100\% \dots \dots \dots \text{Formula (1)}$$

Description :

Va= Expert validation

TSe= Total empirical score (validation results from validators)

TSh= Total maximum expected score

The technique for analyzing readability test data uses the formula from Widoyoko (2018). The formula used can be seen in Formula (2).

$$K = \frac{s}{n} \times 100\% \dots \dots \dots \text{Formula (2)}$$

Description :

K = average readability score

s = total score obtained

n = number of aspects

The technique for analyzing student response test data uses the formula from Ariyawati et al., (2017). The formula used can be seen in Formula (3).

$$R = \frac{\sum x}{N} \times 100\% \dots \dots \dots \text{Formula (3)}$$

Description :

R = percentage score of student responses

$\sum x$ = total score obtained

N = total maximum score

Results and Discussion

Research results are research data obtained after data collection. Meanwhile, the discussion contains the elaboration of the study from the research results that have been obtained and analyzed and must be supported by previous theories. Results and discussion are written separately, by presenting the research results first and then the discussion. Research data can be presented in the form of tables, figures, or graphs. The following is the procedure for creating tables in this script.

1. Analysis

The analysis stage involved using teacher needs questionnaires, and student needs questionnaires to determine what is necessary for creating teaching materials that support biology learning on the sub-concept of the human sensory system. The three analytical stages conducted during the research process are needs analysis, material analysis, and learning objective analysis. The needs analysis includes two aspects: the needs of teachers and students who have studied the sub-concept of the human sensory system in SMA/MA. The results indicate that E-Handouts need to be developed to assist in the biology learning process in the classroom.

2. Design

The design stage involves formulating learning objectives that align with the Learning Objectives Flow (ATP) and Learning Outcomes (CP) for the biology subject on the sub-concept of the human sensory system. The design phase begins with creating the teaching material product as an E-Handout. The choice to use electronic materials as teaching resources is based on the needs analysis results, which identified E-Handouts as necessary. The next step involves selecting the format. The design uses the Canva application, and the E-Handout prototype is created in PDF format and digitized using the website <https://heyzine.com>.



Figure 1. Front and Back Cover of the E-Handout Product.

3. Development

The development stage of the teaching materials in this research includes validity based on expert validation tests, readability tests, and student response tests based on students' assessments of the E-Handout product.

a. Validation

The results of the validity test research for the E-Handout on the sub-concept of the human sensory system by a team of experts. Three validators conducted the validity assessment. The results of the suitability validation by the expert team are presented in Table 1 below:

Table 1. Recapitulation of The Suitability Validation Test Results

Number	Assessment aspect	Validator 1	Validator 2	Validator 3	Average score
1	Learning objectives	49	47	47	47,6
2	Language	16	16	16	16
3	Format	15	13	15	14,3
4	Media	16	16	18	16,6
Total score		96	92	96	94,4
Percentage					85,81%
Conclusion					Very valid

Table 1 shows the average percentage of total assessments by three validators for the E-Handout on the sub-concept of the human sensory system, which is 85,81%, indicating that it is very valid. According to Akbar (2017), the criteria for assessing the validation of E-Handout products are classified as very valid. The results of this expert evaluation indicate that, theoretically and procedurally, electronic teaching material can be used to teach students about the sub-concept of the human sensory system. Experts validate the completeness of educational materials used in the learning process and verify the depth and comprehensiveness of the content presented in the developed product (Marlina et al., 2015; Sari & Iza, 2018). Hikmah et al. (2022) explain that language, media, and content experts conduct validation. The results show a high level of validity for all aspects studied, including an analysis of the validity of the

validator questionnaire. This research emphasizes the importance of collaboration among various experts in developing teaching materials.

The teaching material can be considered valid if the final results meet the previous criteria (Hafiz, 2013). Based on the validation results, the content aspect of the E-Handout product aligns with learning objectives, uses clear and communicative language, and includes appropriate formats and images to clarify the material. This is supported by Rahima et al. (2022), who state that teaching materials should use simple, concise, clear language that is free from ambiguity, as this can affect the communicative quality of the learning resources. According to Utami et al. (2022), aligning presented material with essential competencies, competency achievement indicators, and learning objectives contributes to good learning outcomes.

The aspect with the highest score is the learning objectives, which include meaningful goals for teachers and students and content relevance aligned with learning objectives. The format aspect includes ensuring that the e-handout adheres to proper handout formatting. In line with this, Putra et al. (2020) state that assessment in formal aspects considers scientific writing forms that present evidence in the form of data or images systematically arranged. According to Dewi (2017), media aspects are tested to measure how well illustrations in teaching materials (such as images and tables) clarify content and enhance understanding.

The validation test results from validators provided several inputs and suggestions for further revisions to improve the developed product. Improvements included adjustments to colour schemes and images, among other aspects. This aligns with Putri et al. (2022), who state that validation results will be used to revise initial products.

The results of the feasibility validation by the expert team are presented in Table 2 below:

Table 2. Recapitulation of the feasibility validation test results

Number	Assessment aspect	Validator 1	Validator 2	Validator 3	Average score
1	Cover	12	12	14	12,6
2	Layout	43	41	46	43,3
3	Images and illustrations	19	18	20	19
4	Color	4	4	4	4
Total score		78	75	84	78,9
Percentage		87,11%			
Conclusion		Very valid			

Table 2 shows the average percentage of total assessments by three validators for the E-Handout on the sub-concept of the human sensory system, which is 87,11%, indicating that it is very valid. This aligns with Akbar (2017), who states that the criteria for assessing the validation of E-Handout products are classified as very valid. Design experts evaluated the design experts evaluated the validation sheet for interactive teaching materials. Design experts design experts validated learning media assessing aspects such as cover and layout. The assessment indicates that the developed media is suitable for teaching and learning, with positive comments regarding its visual design (Hikmah et al., 2022). The aspects evaluated include design

feasibility, colour usage, and the appropriateness of images with teaching materials. The validation results show that the developed learning media meets the "very feasible" criteria based on expert assessments (Hakim, 2021).

This feasibility validation aims to obtain data and test the teaching materials' suitability to improve the developed product, which can be evaluated based on aspects such as cover, layout, images and illustrations, and colour. Based on the validation results, the content aspect of the E-Handout product is deemed suitable for use as teaching material in terms of cover, font accuracy, design consistency, and font usage throughout the material. The aspect with the highest score is images and illustrations, including images and illustrations that effectively convey messages. This aligns with Dewi et al. (2010), who state that teaching materials can be engaging when they use images or illustrations that clarify content and make it easier for students to understand. Attractive images with original colours are visual elements that provide a realistic impression of an object or situation depicted, enhancing learning appeal and student attention while clarifying ideas, illustrations, or facts related to the material being studied and providing meaning and information used in learning (Arsyad, 2011; Riefani et al., 2020). According to Suswina (2011), a topic or subject matter requires examples and illustrations that can aid in students' understanding.

The validation test results from validators provided inputs and suggestions for revisions to improve the developed product for student use. Improvements included enhancing learning objectives and revising concept maps into flow diagrams. This aligns with Rahima et al. (2022), who state that teaching materials are essentially systematically organized resources that provide a comprehensive overview of the skills students will master.

b. Readability test

The readability test for developing the E-Handout as teaching material on the sub-concept of the human sensory system for Class XI in SMA/MA was conducted using a readability questionnaire. The readability test was completed by nine students who had studied biology, precisely the material on the human sensory system, consisting of three students with high academic ability, three with medium academic ability, and three with low academic ability. The results of the readability test by the students are presented in Table 3 below:

Table 3. Recapitulation of Readability Test Results

Number	Assessment aspect	Average score
1	Pleasant	4,22
2	Utility	4,22
3	Stimulation	4,56
4	Strength	4,67
5	Effective	8,44
6	Clarity	13,10
7	Relevant	13,55
8	Practical	8,88
9	Helpful	9
10	Appropriate	9
11	Beneficial	4,33
12	Latest	4,44
13	Interest	4,56
14	Interesting	4,56

Number	Assessment aspect	Average score
15	Efficiency	4,44
16	Cost	4,44
17	Valuable	4,44
	Total score	110,85
	Percentage	88,68%
	Conclusion	Very good

Table 3 shows the average percentage of total assessments by students for the E-Handout on the sub-concept of the human sensory system, which is 88,68%, indicating that it is perfect. [Widoyoko \(2018\)](#) states that this falls into the "outstanding" category. Factors such as the number of new words or terms used, sentence length, the number of syllables in a paragraph, and the grammar employed can affect the readability of a learning resource ([Chen, 2012](#)). Factors like word and sentence complexity and the reader's background knowledge significantly influence readability ([Fatin et al., 2018](#)). [Prabawati \(2019\)](#) states that sentence length and word difficulty contribute to text readability. This research indicates that the text becomes more challenging for students to understand as sentence length increases.

The developed e-handout teaching material uses concise and straightforward language that is easy for students to comprehend, along with various images and videos and an attractive design that engages students in learning with this material. Additionally, it can be easily accessed anywhere due to its electronic format. The aspect with the highest score is the strength of the e-handout in enhancing students' reading interest. In contrast, the relevant aspect indicates that the content of the e-handout aligns with the curriculum. This aligns with [Riefani and Mahrudin's \(2020\)](#) explanation that products should match students' understanding levels and abilities in content and language. This includes selecting appropriate language and vocabulary, organizing paragraphs, and using effective sentences.

The validation test results from students provided several inputs and suggestions for revisions, including clarifying images displayed to make them more straightforward when viewed. [Damayanti et al. \(2022\)](#) support this, stating that using images (visuals) will enhance concentration during learning and assist students who struggle to understand learning materials. According to [Utami et al. \(2022\)](#), easily readable text influences students' reading preferences, memory, and efficiency.

c. Student response test

Students' responses to developing the E-Handout as teaching material on the sub-concept of the human sensory system for Class XI in SMA/MA were obtained using a student response questionnaire. The response test was completed by nine students who had studied biology, precisely the material on the human sensory system, consisting of three students with high academic ability, three with medium academic ability, and three with low academic ability. The results of the student response test are presented in Table 4 below:

Table 4. Recapitulation od Student Response Test Results

Number	Assessment aspect	Average score
1	Feasibility and use	35,66
	Total score	35,66
	Percentage	89,15%
	Conclusion	Sangat Baik

Table 4 shows the average percentage of total assessments by students for the E-Handout on the sub-concept of the human sensory system, which is 89,15%, indicating that it is perfect. According to [Ariyawati et al. \(2017\)](#), this falls into the "very good" category. The student responses to the E-Handout product were conducted to determine whether users accepted the developed E-Handout well. According to [Fitriani et al. \(2023\)](#), student responses refer to students' feedback on the developed media. Student responses tend to be higher if they feel more interested. A questionnaire was administered to gauge student responses. When a reaction occurs, several factors influence it, including experience, education, and personality traits ([Hidayati & Nur, 2013](#)).

The student responses to the E-Handout product aimed to assess whether users accepted the developed E-Handout well. According to [Fitriani et al. \(2023\)](#), student responses reflect students' feedback on the media developed. Responses will be higher if students feel more engaged. A questionnaire was distributed to assess student responses. The aspect with the highest score is feasibility and usability, which includes the appropriateness of images and content in the e-handout and how its use enhances knowledge and understanding. This aligns with [Putri's \(2019\)](#) explanation that handouts are materials teachers create to enhance students' knowledge. Handouts are also designed to assist students in obtaining information during the learning process.

The results of student responses provided several inputs and suggestions for revisions, including improving images related to the discussion of the sense of sight to meet the needs of the developed teaching materials. [Indasari \(2016\)](#) supports this, stating that engaging learning resources with concise, explicit material can be an independent learning source. According to [Tafonao \(2018\)](#), better teaching materials increase students' curiosity and help them achieve optimal learning objectives during the learning process. [Emzir \(2012\)](#) notes that products developed through research must be thoroughly tested, evaluated, and improved until they meet performance or quality standards.

The developed E-Handout possesses several distinctive characteristics that make it an engaging teaching material, including systematic presentation supported by clear images and illustrations, as well as components that support learning such as scheduling and mapping of material, concept maps, evaluation questions, additional information, and questions that engage students in critical thinking and skill development. [Hidayah \(2019\)](#) mentions that concept maps can help students think and demonstrate their thought processes. In line with this, [Hanif et al. \(2016\)](#) state that evaluation questions are created by learning objectives and material. Students can use evaluation questions or practice exercises to reinforce their understanding of the concepts being studied. According to [Hidayati \(2020\)](#), additional information aims to give students extra insights regarding the studied concepts. The information presented

often includes material readily encountered daily to help students better understand the subject matter.

One advantage of handouts is that they provide a comprehensive description of the human sensory system's functions, characteristics, and images of human organs, making it easier for students to understand this material. Furthermore, the developed e-handout is written and uses straightforward language that is concise and clear, relying on thought rather than adhering strictly to scientific writing rules; thus, it captures readers' interest and is easy for students to comprehend. It is easy to study, not dull, and portable, allowing for study anytime and anywhere. Consequently, learning about the sub-concept of the human sensory system using the E-Handout can proceed effectively. This is explained by Akbar (2017), who states that effective learning is interactive, inspiring, challenging, and encourages active student participation. Using colourful images in teaching materials helps motivate students, foster interest, strengthen memory retention, and enhance critical thinking skills (Riefani, 2019). According to Ayuningrum & Mulyono (2022), E-Handouts can be self-learning resources at home because they are efficient and can be taken anywhere without requiring data connectivity.

Conclusion

The development of E-Handout teaching materials for this study's sub-concept of the human sensory system refers to three stages: the analysis stage, the design stage, and the development stage. The results of the suitability validation showed a percentage score of 85,81%, indicating a very valid criterion. The feasibility validation had a percentage score of 87,11%, indicating a very valid criterion. The readability test results from 9 students yielded a percentage score of 88.68%, indicating an excellent criterion. The student response test results from 9 students showed a percentage score of 89,15%, indicating an excellent criterion.

In conclusion, the developed E-Handout possesses several unique characteristics that make it an engaging teaching material, including a systematic presentation of content supported by clear images and illustrations, as well as components that support learning materials such as scheduling and mapping of content, concept maps, evaluation questions, additional information, and questions that engage students in critical thinking, thereby enhancing their skills. Theoretically and procedurally, electronic teaching materials can teach students about the sub-concept of the human sensory system.

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