

**DEVELOPMENT OF MULTIPLE INTELLIGENCES-BASED STATISTICS E-
BOOKLET TO IMPROVE THE LEVEL OF STUDENTS' STATISTICAL
LITERACY SKILLS**

THESIS

To meet some of the requirements
Obtaining an S-2 Degree
Master of Mathematics Education Study Program



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January 2025

**DEVELOPMENT OF MULTIPLE INTELLIGENCES-BASED
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1. The thesis entitled : **DEVELOPMENT OF MULTIPLE INTELLIGENCES-BASED STATISTICS E-BOOKLET TO IMPROVE THE LEVEL OF STUDENTS' STATISTICAL LITERACY SKILLS**, is my original work and contains no one's scientific paper that may be proposed to achieve an academic degree at any universities. Besides, there is no other's idea or citation except those which have been quoted and mentioned at the bibliography.
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Thus, this statement is made truthfully to be used as appropriate.

Malang, 03 January 2025

The Writer,



ALI AKBAR

FOREWORD

Praise Allah SWT for bestowing His grace and guidance so that the author can complete the thesis titled "Development of Multiple Intelligences-Based Statistics E-Booklet to Improve the Level of Students' Statistical Literacy Skills". Prayers and greetings are continuously poured out to the Prophet PBUH. The author realizes that the writing of this thesis can be completed thanks to the guidance, assistance, and motivation from many parties. Therefore, with sincerity, the author expresses his respect and gratitude to:

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Malang, January 3, 2024



Ali Akbar



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ABSTRACT

Ali, Akbar. 2024. Development of Multiple Intelligences-Based Statistics e-Booklet to Improve the Level of Students' Statistical Literacy Skills. Thesis. Mathematics Education Study Program, Postgraduate Program, University of Muhammadiyah Malang, Supervisors: (1) Prof. Dr. Baiduri, M. Si, (II) Dr. Agung Deddiliawan Ismail, M.Pd.

This research aims to develop a valid and effective multiple intelligences-based statistical e-booklet (MI e-booklet) to improve students' statistical literacy skills. This research was conducted using a Research and Development (R&D) approach with a Borg and Gall development model with eight steps: (1) research, (2) planning, (3) developing product, (4) preliminary field testing, (5) main revision product, (6) main field testing, (7) final revision, and (8) Implementation. The research method is a Pre-experimental one, group pretest-posttest design, and the subject of this study consists of 4 validators (media and materials) for the validity of the MI e-booklet, small group students (10 students) and large group students (30 students) to see the effectiveness of the MI e-booklet. The type of research data is questionnaires, assessment scales, interviews, and tests with data analysis using data triangulation, scoring, and prerequisite tests for normality and homogeneity of data, paired sample t-tests, and N-gain tests. The results of the validation of the MI e-booklet developed to have a very high level of validity based on the assessment of material and media expert validators. Field trials also showed that the MI e-booklet was effective in improving the level of students' statistical literacy skills because it had good readability in small-group subjects, and statistical testing of the test in large groups found that the $p\text{-value} < \text{Sig. (2-tailed)}$, which means H_1 was accepted with an N-gain value of 0.52 in the moderate effectiveness category. Thus, the e-booklet of statistics based on multiple intelligences is declared valid and effective for use as a learning medium and contributes positively to improving students' statistical literacy skills.

Keywords: E-booklet, Multiple Intelligences, Statistical Literacy, Media Development

ABSTRAK

Ali, Akbar. 2024. Pengembangan E-Booklet Statistika Berbasis Multiple Intelligences Untuk Meningkatkan Level Kemampuan Literasi Statistik Siswa. Tesis. Program Studi Pendidikan Matematika, Program Pascasarjana Universitas Muhammadiyah Malang, Pembimbing: (I) Prof. Dr. Baiduri, M. Si, (II) Dr. Agung Deddiliawan Ismail, M.Pd.

Penelitian ini bertujuan untuk mengembangkan *E-booklet* statistika berbasis *multiple intelligences* (e-booklet MI) yang valid dan efektif untuk meningkatkan level kemampuan literasi statistik Siswa. Penelitian ini dilakukan dengan menggunakan pendekatan *Research and Development (R&D)* dengan model pengembangan Borg and Gall dengan 8 langkah: (1) *research*, (2) *planning*, (3) *develop product*, (4) *preliminary field testing*, (5) *main revision product*, (6) *main field testing*, (7) *final revision* dan (8) *Implementation*. Metode penelitian yaitu *Pre-experimental one group pretest posttest design* dan Subjek penelitian ini terdiri dari 4 orang validator (media dan materi) untuk validitas e-booklet MI, siswa kelompok kecil (10 siswa) dan siswa kelompok besar (30 siswa) untuk melihat efektifitas e-booklet MI. Jenis data penelitian berupa angket, skala penilaian, wawancara dan tes dengan analisis data menggunakan triangulasi data, skoring dan uji prasyarat normalitas dan homogenitas data, uji *paired sample t-test* dan *N-gain*. Hasil validasi e-booklet MI yang dikembangkan memiliki tingkat validitas yang sangat tinggi berdasarkan penilaian validator ahli materi dan media. Uji coba lapangan juga menunjukkan bahwa *e-booklet* MI efektif dalam meningkatkan level kemampuan literasi statistik siswa karena memiliki keterbacaan yang baik pada Subjek kelompok kecil dan pengujian statistik tes pada kelompok besar ditemukan bahwa $p\text{-value} < \text{Sig. (2-tailed)}$ yang berarti H_1 diterima dengan nilai *N-gain* sebesar 0,52 pada kategori efektivitas yang sedang. Dengan demikian *E-booklet* statistika berbasis *multiple intelligences* dinyatakan valid dan efektif untuk digunakan sebagai media pembelajaran serta memberi kontribusi positif terhadap peningkatan level kemampuan literasi statistik siswa.

Kata Kunci : *E-booklet*, *Multiple Intelligences*, Literasi statistik, Pengembangan Media.

A. INTRODUCTION

The development of the 21st century has changed various contexts of human needs to be knowledge-based. The 21st century is also called the knowledge (Wijaya et al., 2016) age, where knowledge is the primary basis in the economy (knowledge-based economy), development (knowledge-based social empowering), industry (knowledge-based industry), and education (knowledge-based education). In line with that, the development of information is increasingly rapid, so it requires mastery of the ability to sort, read, and interpret information. The ability to understand data should be introduced as early as possible, especially in the world of education. Therefore, preparing to face the challenges of the times requires teachers or academics to prepare students to have additional abilities, namely statistical literacy, that can be processed in statistical learning (Andriatna & Kurniawati, 2021; Abdullah & Suhartini, 2017)

Statistics learning is one of the core topics in mathematics learning, both at the school and university levels. Statistics material in the independent curriculum (Takaria & Rumahlatu, 2016; Widya, 2023) at the elementary school level includes basic statistics; general statistics includes simple data collection and presentation at the junior high school to the high school level, namely statistical materials related to probability or simple statistical methods, and inferential and advanced statistics at the university level (Ministry of Education and Culture, 2022). Statistics are essential for students to understand based on the material's content (Danial et al., 2022)

Statistics is the knowledge of how a person collects data to interpret it (Guven et al., 2021). Statistics is related to calculation operations and includes problems in life, so it has an important role (Obrial & Lapinid, 2020). The importance of statistical knowledge, for example, is used in interpreting data from the statistical center regarding information in the form of summary numbers about the population; then, in educational institutions and government agencies, it is often presented in the form of tables and graphs, such as data on the number of students, the number of teachers, the number of employees, structural positions, and important information in other fields (Hariyanti & Wutsqa, 2020. Essential

competencies in statistics include (1) understanding the importance of data and basic concepts of statistics, (2) collecting and describing data, (3) interpreting, and (4) communicating results (Rumsey, 2002). Based on statistical competence, it can be said that the purpose of statistical learning is to improve statistical literacy (Gal, 2002).

Statistical literacy is an essential component in learning statistics. Statistical literacy is related to trans-numerative thinking, used to understand data and representation to understand the surrounding environment. Statistical literacy describes the skill of understanding factually but also in a critical attitude toward data and information. Statistical literacy is divided into two parts, namely, the knowledge aspect and the character aspect. The knowledge aspect includes literacy, statistics, mathematics, context, and critical questions, while the character aspect includes critical attitudes, beliefs, and attitudes. Statistical literacy is the ability students need to understand data and information; this can be seen in research that there are two urgency of statistical literacy; first, statistical literacy can help students understand, interpret, and represent data in tables and graphs. Second, students who have statistical literacy will feel comfortable handling quantitative decisions and life issues (Watson, 2013 ;Gonda et al., 2022; Gal, 2002; Hafiyusholeh, 2015)

Statistical literacy is indispensable for every educational actor, considering that each element can play a role as a consumer of statistical data. In line with that (Gould, 2017; Widya, 2023; Rohayati et al., 2020), statistical data in the digital era is a reference in various private and public decision-making. Statistical literacy also plays a vital role in developing science and technology. Given the importance of statistical literacy in modern life, introducing statistics to students should be done as early as possible, and research on statistical literacy needs to be studied further. (Kusmanto, 2017; E. P. Setiawan & Sukoco, 2021; NCTM, 2002)

A literacy level survey conducted by the Program for International Student Assessment (PISA) released by the Organization for Economic Co-operation and Development (OECD) in 2018 ranked Indonesia 72nd out of 78 countries. In line with that, several studies show that statistical literacy skills are still in the low

category. Other research on statistical literacy analysis for several indicators, such as reasoning against basic statistical concepts and data interpretation, still shows results that have not met expectations. Therefore, it is necessary to learn statistics more meaningfully by developing learning media innovations or preparing teaching materials by considering the level of statistical literacy through further research suggestions. (OECD, 2019; Hafiz & Atiqoh, 2023; Khaerunnisa & Pamungkas, 2017; Maryati & Priatna, 2018; Noviantari & Faridhoh, 2021; Andriatna et al., 2021; Moh Hafiyusholeh 2015; Andriatna and Kurniawati, 2021; Habibie and Hidayat 2022)

One of the causes of low statistical literacy skills is a lack of interest in learning and the lack of variety of media used in the learning process. Learning should be designed in a conducive atmosphere so that it can be accepted by various student conditions such as characteristics, learning styles, interests, talents, and various intelligence. Learning should also utilize technology-based media to learn and simplify abstract mathematical concepts. In line with that (Rosiyanti & Farahdiba, 2022; Prajitno & Ladyawati, 2019; Yaumi, 2021). Baiduri et al. (2019) it was revealed that the use of interactive technology media makes students more excited, increases focus, and tends to be stored in students' long-term memory. Therefore, the design of technology-based learning media that accommodates every student's intelligence is essential for further research.

Based on the results of the researcher's initial study on students' initial ability to perform statistical literacy and the use of learning media at the research location, The analysis of mathematics test scores, especially on student statistics material, showed that out of the five questions tested, only an average of 20% of students could answer correctly. GM. Sya said students' abilities are different when given practice and test questions. Furthermore, the resource person added that the statistical material is in the final sub-chapter, so learning is not optimal. The questionnaire results also showed that the availability of learning media was inadequate, and teachers had never used e-booklets in the learning process. This strengthens the researcher's assumption that developing an e-booklet based on multiple intelligences is necessary.

E-booklet is an electronic-based learning medium that aims to make it easier for students to learn independently. There are several developments of E-booklets in the world of education, but there has been no research (Azizah & Iswari, 2021; Hanifah et al., 2020; Hendrianti et al., 2021; H. Setiawan & Wardhani, 2018; Yulianti & Kumala, 2019) E-booklets on statistical materials and utilizing multiple intelligences approaches. The research results developed a module based on multiple intelligences (Prajitno & Ladyawati, 2019), resulting in the module meeting the criteria for practical use in discrete mathematics learning. Other research also states that e-books based on multiple intelligences are valid in practicing critical thinking skills (Sofa and Indana 2021).

Referring to some of the things that have been explained, this study aims to produce an e-booklet based on multiple intelligences to maximize every aspect of students' intelligence in increasing their statistical literacy skills. Specifically, the purpose of this study is first to see the validity of the multiple intelligences-based statistical e-booklet that has been produced and second, to determine whether the statistics e-booklet based on multiple intelligences is efficacious in improving the level of students' statistical literacy skills.

B. LITERATURE REVIEW

1. E-Booklet

E-booklets consist of two words, "E," which refers to electronic learning, or e-learning, a computer-based educational device or system that allows a person to learn anywhere. The term (Horton, 2011) e-learning is divided into two, namely learning by utilizing information and communication technology (electronic-based e-learning) and online-based learning (internet-based) as the leading learning resource. According to (Muhammad Rusli, Hermawan, and Supuwingsih 2020), a "Booklet" is a type of media in the form of a relatively small book containing information and practical knowledge about a particular subject or field. The word (Personal 2017) booklet comes from books and leaflets, which means a booklet is a book with a small format such as a leaflet; a booklet only contains pictures and writing with a maximum of 5 pages and no more than 48 pages outside of the cover

calculation. Referring to this explanation (Raja, Febrianti, and Ardiansyah, 2022), an E-booklet is a medium to convey subject matter through summaries with attractive and electronic-based images.

E-booklets are used as examples of copyrighted works related to products. Therefore, in creating e-booklets, it is necessary to pay attention to the preparation of the material, which must be as attractive as possible because appearance is the main attraction. (Simamora and Kep 2009) E-booklets are similar to e-books; the only difference is the media size used. E-booklets have more concise content than e-books, although their use in interactive media will remain the same. (Alfarid 2023)

a. Features of E-booklet

1) Form E-booklet

- a) Accessed from smartphone and laptop electronic networks
- b) Neat arranged in the shape of a book
- c) Load images and other components.

2) Contents of the E-booklet

- a) As information that contains events or materials
- b) The content is easy to understand at a glance.

b. Advantages of E-Booklet

- 1) E-booklets are made in electronic or digital form, so the cost incurred is less.
- 2) Making an e-booklet to become a product can be done at any time.
- 3) The process of submitting the content in the e-booklet can be adjusted to existing conditions.
- 4) It is easy to carry and use anywhere because it is enough to use an Android cellphone, laptop, or computer connected to the internet.
- 5) The appearance of the e-booklet is more varied, with attractive colors, images, photos, and graphics.
- 6) The e-booklet can be linked with links and videos.
- 7) The content in the e-booklet is more detailed and precise because it allows the review of the message conveyed directionally.

c. Disadvantages of E-Booklet

- 1) E-books cannot be spread directly to all objects due to the limited number of pages that can be loaded.
- 2) To create an attractive e-booklet, creative experts are needed to design and compile this media.

d. E-Booklet Preparation Techniques

- 1) Visible is to contain content that is easy to understand (Aqib, 2013)
- 2) Interesting is interesting
- 3) Simple is simple
- 4) Useful is helpful for educational sources
- 5) Accurate, which is correct and on target
- 6) Legitimate is legitimate and reasonable
- 7) The Structure is well-arranged and collapsed

e. Steps to Prepare an E-Booklet

- 1) The title is derived from the KD or sub-material according to the size of the material. (Prastowo 2019)
- 2) KD/sub-material is to be achieved and derived from SI and SK.
- 3) The content conveyed is clear, concise, and engaging, paying attention to the presentation of sentences that are adjusted to the age and experience of the reader.
- 4) In the E-Booklet, pictures are inserted so it does not seem monotonous.
- 5) The content is arranged based on the needs of students
- 6) Easy to take anywhere and carry anytime, anywhere
- 7) It contains complete information, even if it is not detailed and sequential.

2. Multiple Intelligence

Intelligence is a gift from God that shows the superiority of human beings over other creatures. In line with that, it states that humans can maintain and improve the quality of life to a complex stage through a continuous thought process with the help of their intelligence (Madyawati, 2016). Intelligence is not focused on a single topic and is limited to when humans are born, but every human being has

diverse intelligence, known as multiple intelligences. According to Gardner, multiple intelligences is the (Hermita, 2017) ability to solve problems in life, take on new problems, and do something useful.

Gardner (1998) revealed several types of intelligence in theory: musical intelligence, bodily-kinesthetic intelligence, logical-mathematical intelligence, linguistic intelligence, visual-spatial intelligence, interpersonal intelligence, intrapersonal intelligence, and naturalistic intelligence. The explanation of some of the intelligences in Gardner's theory is as follows: (Gardner & Asensio, 1998)

a. Musical intelligence

Musical intelligences emerged as the first intelligences in human development. A person receives the basic material of musical intelligence through the heartbeat, pulse, and digestive sounds in the mother's womb. Music is an art that comes from human thought about tones or sounds creatively assembled to form rhythm and harmony. Wayan (2021) added that through the combination of vocal voices and musical instruments, music is an art and a means of entertainment, education, and health maintenance as long as it is used wisely and optimally. Gardner argued that musical intelligence is at the core of the human experience and is the starting point of the development of individual intelligence. The musical intelligence referred to in this study is the ability of students to play instruments, sing, and write songs with the basic components of music melody, rhythm, tempo, harmony, and musical form, as well as interpret the meaning of the music itself. (Campbell, 2001; Wayan, 2021)

b. Bodily-Kinesthetic intelligence

Kinesthetic intelligence is the ability to skillfully use the body to express ideas, thoughts, and feelings that allow for effective coordination between the brain and human gestures. The benefits of optimizing kinesthetic intelligence are not only felt in supporting daily activities. However, athletes, dancers, acrobats, sports teachers, and choreographers can also produce extraordinary body skills. In line with that, it states that human kinesthetic intelligence makes it possible to establish an important connection between mind and body. (Gardner and Asensio 1998; Mayar and Putri 2021)

Stimulation of kinesthetic intelligence can be trained with several activities, including (1) Coordination between eyes, hands, and feet, such as drawing, writing, throwing, kicking, and catching (2) Locomotor skills, such as walking, running, jumping, rolling, marching and crawling, (3) Non-locomotor skills such as bending, reaching, turning the body, swinging and squatting, (4) the ability to control and regulate the body such as showing body awareness, spatial awareness, rhythmic, stopping and changing direction. (Acesta 2019)

c. Logical-Mathematical intelligence

Mathematical logic intelligence refers to a person's ability to understand and work with numbers and logic to solve problems. Individuals with mathematical logic intelligence can develop solutions in a logical order that makes sense. One will be interested in numbers, sequences, logic, and regular patterns. This logical intelligence involves understanding relationship patterns, as well as the ability to carry out deductive and inductive thinking processes, which involve reasoning from big things to small things, and inductive thinking processes involve reasoning from small things to big things (Gardner & Asensio, 1998; Suarca, Soetjningsih, and Ardjana 2016).

d. Linguistic intelligences

Linguistic intelligence is a form of empirical intelligence focused on word processing, which means the ability to use words effectively both orally and in writing. Language intelligences involves four skills: listening, writing, reading, and speaking. Madyawati added that children with linguistic skills can read and understand what is being read, respond well in verbal communication, write and speak effectively, and use a wide range of words (Gardner & Asensio, 1998; Madyawati, 2016).

e. Visual-Spatial intelligence

According to Gardner (1993), spatial-visual intelligence is the ability to observe and understand the visual world and refer to images, while spatial is related to space or place. Spatial intelligence of images involves awareness of colors, lines, shapes, space, size, relationships between elements, and the

ability to see objects from various perspectives. Some signs of spatial visual intelligence in children include memorizing directions and street names, remembering house plans, drawing accurately, creating buildings in various media, and having fun playing puzzles (Fauzia, 2023; Madyawati, 2016).

There are several signs of a child with spatial-visual intelligence: (1) Able and quickly interested in seeing images, shapes, colors, spaces, and objects. (2) Easily remember the location of objects and the location of objects with space. (3) Have a high imagination and be able to imagine something that is not seen. (4) Enjoy designing or drawing and playing games with computers. (5) Enjoy reading maps. (6) Skilled in adjusting the picture's color, the result is good (Subroto, 2023).

f. Interpersonal intelligence

Interpersonal intelligence is understanding people and fostering effective relationships with others. This intelligence is known as emotional intelligence, which characterizes an individual's ability to manage and understand emotional aspects. Indicators generally include sensitivity to feelings, ease of interacting and building relationships, effective leadership, and the ability to understand and feel the emotions of others. Individuals with this interpersonal intelligence tend to have talents for careers such as business leaders, motivators, politicians, journalists, and marketers, where communication skills and understanding other people's emotions are indispensable. Therefore, (Gardner & Asensio, 1998; Uno & Umar, 2023; Acesta, 2019) to have interpersonal intelligence, students are trained to work together, work in groups, establish rules of behavior, provide opportunities to be responsible, solve problems together, carry out social activities, respect differences of opinion, be humane, patient and understand cultural diversity.

g. Intrapersonal intelligence

Gardner (1993) defines intrapersonal intelligence as a form of intelligence that leads to knowledge of a person's internal aspects, emotions, and feelings, distinguishing and using emotions to control a person's behavior. People with intrapersonal intelligence usually have high confidence and feel

happy working independently, following personal programs, and doing activities alone (Puspitarini 2014).

h. Naturalistic intelligences

Gardner's idea of naturalist intelligence emerged in 1995 and was published in 1997. It was initially in the ability to perceive the forms and elements that exist in nature. Naturalistic intelligence includes the ability to recognize and classify patterns in nature and the surrounding environment, both flora and fauna, and generally shows a great interest in the environment, animals, and plants, as well as having the ability to recognize and distinguish species. In line with that (Suarea, Soetjningsih, and Ardjana 2016; Morris, 2004; Armstrong, 2009), naturalist intelligence is sensitivity to nature and the environment in which they live, so in the case of children living in urban areas, this intelligence is in the form of the ability to distinguish inanimate objects such as cars, shoes, and stationery.

This research aims to develop learning media in the form of e-booklets, where the preparation of the e-booklet is expected to accommodate every multiple intelligence owned by students adapted from Howard Gardner's theory. The e-booklet development grid based on multiple intelligences only includes intelligence six as follows:

Table 2. 1 Content Standards for the Preparation of E-Booklets Based on MI

No	Types of intelligences	Content standards
1	Musical intelligence	Create a feature containing material and statistical evaluation modified into songs and lyrics.
2	Logical-mathematical intelligence	Create features containing modified statistical material and evaluation into mathematical reasoning
3	Linguistic intelligences	Create a feature containing statistical material and evaluation that is modified into a comment column, acronyms, and discussion methods.
4	Visual-spatial intelligence	Create a feature that contains material and statistical evaluations that are modified into videos.

5	Interpersonal intelligence	Create features containing modified materials and statistical evaluations into project-based materials
6	Intrapersonal intelligence	Create a feature containing modified statistical materials and evaluations into a standalone task.

3. Statistical literacy

a. Definition of Literacy

Literacy in English is written with literacy from the Latin word "litter," which means letter or letter, so literacy is often translated as literacy. Literacy is concerned with the ability to read and write, including identification, comprehension, interpretation, creation, communication, and calculation using printed and written materials in various contexts. Literacy is not just a static skill but involves continuous learning that allows individuals to achieve their goals, develop personal knowledge and potential, and actively participate in communities and societies (UNESCO, 2004; 2017). In addition, literacy also includes understanding, evaluation, use, and engagement with written texts as a means to participate in society, achieve personal goals, and develop one's knowledge and potential (Aswita et al., 2022; Malawi, Tryanasari, and Apri Kartikasari 2017; Coulson & Ostler, 1977; Montoya, 2018; OECD, 2000).

Literacy skills, according to the OECD (2000), are needed or used in three groups of knowledge or domains the domains of atretic skills as follows:

Table 2. 2 Literacy Skills Domain

Domain	Skills
Prose Literacy	Knowledge and skills required to understand and use information from text, including editorial, news browsing, and instruction manuals
Document Literacy	Knowledge and skills required to find and use information contained in formats such as job applications, forms, schedules, maps, tables, and charts
Quantitative Literacy	Knowledge and skills required to apply arithmetic operations, sequences, and numbers, such as

checkbooks, figuring out tips, filling out order forms and loan interest and others."

Literacy has several domains of knowledge or how literacy is allocated. Based on the explanation of the table above, literacy is not only used in the context of knowledge, such as understanding but literacy can also be used in more complex things, such as compiling one's statistical abilities. In line with that, Mujib (2017) mentioned that literacy is divided into nine categories, namely: Information literacy, statistical literacy, technology literacy, visual literacy, critical literacy, data literacy, digital literacy, financial literacy, and health literacy (Maryati & Priatna, 2018)

b. Definition of Statistical Literacy

Statistical literacy is defined as 'literate' statistics. Statistical literacy is interpreting, evaluating, and communicating statistical information. Some literature explains that statistical literacy leads more to the ability to read and interpret statistics presented in the mass media. According to (Gal, 2002; Ben-Zvi & Garfield, 2004; Garfield & DelMas, 2010; Rumsey, 2002). Wallman, (1993) "Statistical literacy is the ability to understand and critically evaluate statistical results that permeate our daily lives coupled with the ability to appreciate the contributions that statistical thinking can make in public and private, professional and personal decisions." Meanwhile, it states that statistical literacy is a person's ability to read, interpret, and present data. Based on these definitions, statistical literacy can be interpreted as understanding, interpreting, and communicating statistics (M. Hafiyusholeh, Budayasa, and Siswono 2018).

Many experts have defined statistical literacy, but only a few experts have explored statistical literacy in depth, one of which is Gal. According to Gal, The statistical literacy model consists of two elements: the knowledge element and the dispositional element. The knowledge element consists of five elements: literacy skills, statistical knowledge, mathematical knowledge, context knowledge, and critical questions. Meanwhile, the elements of disposition are beliefs, attitudes, and critical stance. The following is an

explanation table of each element of the statistical literacy model according to (Gal, 2002)

c. Statistical Literacy Indicators

Statistical literacy is a process of understanding, processing, and interpreting data. The statistical literacy indicators in this study are based on the definitions of experts and adaptations of the research. The indicators of statistical literacy are described as follows: (Ben-Zvi & Garfield, 2004; Gal, 2002; Garfield & Delmas, 2010; Rumsey, 2002; Schield, 2011; Utomo, 2021)

Table 2. 3 Indicators of Statistical Literacy Ability

Aspects	Information
Problem Understanding	Able to write down what is known and what is asked in the question.
Data Processing	Able to carry out data processing by the strategy.
Data Interpretation	Able to write conclusions based on the given problem.

d. Statistical Literacy Level

Statistical literacy is built from six levels as revealed by which it consists of level 1 Watson & Callingham (2004; Ham (2004) (Idiosyncratic), level 2 (Informal), level 3 (Inconsistent), level 4 (Consistent Non-Critical), level 5 (Critical), and level 6 (Critical Mathematical). Levels 1 and 2 are limited to the term and meaning of statistics, levels 3 and 4 already state statistics in context, and levels 5 and 6 express critical thinking, including questioning the truth of the data. Further developments reduced the literacy level to four levels that led to the taxonomy of Biggs and Collis' thinking, namely the first level (Sharma, 2017) of Informal/Idiosyncratic, the second level of Consistent Non-Critical, the third level of Early Critical and the fourth level of Advanced Critical, where the literacy level shows the thinking process from the unadorned stage to the critical stage.

1) Level 0 -1 Informal/Idiosyncratic

Students at this stage exhibit pre-structural or most uni-structural thinking characteristics: Only informal engagement with context, which

often reflects non-statistical intuitive ideas and beliefs. Because of difficulties in reading or writing, the students cannot explain their thoughts and often guess the answers. Regarding statistical terminology, the students gave random or inappropriate explanations. Students tend to focus on imaginative storytelling or inappropriate aspects when making inferences. The students used subjective reasoning to explain the central size or distribution of data. The questions asked are not data-based or focused on irrelevant contextual issues. The students succeed in reading some basic tables and graphs, as this requires understanding a single element and reading a simple one-step.

2) Level 2 Consistent Non-Critical

The students at this stage show the characteristics of uni-structural and multi-structural thinking; students focus on one relevant aspect or try to pay attention to one or more relevant aspects of the data but experience difficulties in integrating those aspects. Engagement that is appropriate but not context-critical. Accurate statistical skills are related to simple statistics and chart characteristics. A single or partial comparison is correctly made in a data table or graph. A general or singular statement is made about the data collection method and the findings' validity without reference to context. The questions are valid but based on one aspect of the data.

3) Level 3 Early Critical

The students at this stage begin to show the characteristics of relational thinking. Students at this stage can notice more than one relevant aspect of the data and begin to integrate those aspects. There is critical involvement in familiar contexts. There is selective involvement with unknown contexts for several reasons. There is the use of appropriate terminology, qualitative interpretations of possibilities, and an appreciation of variation. Students demonstrate awareness of the relevant features of data display, center size, and distribution. However, this is mainly based on data or context, but not both. Data-related questions are

based on multiple aspects of a data task but are not always connected. The students tend to associate several elements with data collection methods and graphs; They can manage two variables simultaneously.

4) Level 4 Advanced Critical

The students at this stage integrate statistical and contextual knowledge that demonstrates extended abstract thinking. The students can relate several aspects of the task together as a basis for prediction, generalization, reflection, or the formation of new understanding. There is critical engagement, and it is full of questions with context. There is an understanding of the purpose of the data, the display of the data, the size of the center, and the inference made. A critical evaluation of the data collection method, the choice of size, and the validity of the findings shows respect for variation and the need for uncertainty in making predictions. Advanced statistical and mathematical skills are linked to success at this stage, especially in media. There is an ability to interpret subtle aspects of language. The questions asked are based on the relevant features of the data and context using several perspectives.

The hierarchy model above describes the thought process from simple stages to more critical stages. At level 1, the focus is still on the basic understanding of terms and the meaning of statistics. At level 2, the thinking process involved contextualizing and presenting statistics in context. Meanwhile, levels 3 and 4 have elements of critical thinking, including questioning the truth in a report or statistical data. (Sharma 2017)

Table 2. 4 Statistical Literacy Ability Level

Level	Characteristic
0 -1 Informal /Idiosyncratic.	Focus on informal engagement with context and often use non-statistical ideas that are intuitive
2 Consistent Non-Critical.	Focusing on one relevant aspect or paying attention to several relevant aspects but having difficulty integrating them, proper engagement but not critical to the context, use of accurate statistical skills including simple statistics and chart characteristics, correct

	comparisons are made singly or partially in tables or graphs
3 Early Critical	Critical engagement in known contexts, including selective on unknown contexts that require justification, appropriate use of terminology, and qualitative interpretation
4 Advanced Critical	Critical engagement by questioning context, having an understanding of the purpose of the data, and the presentation of the data, including inferences made, mathematical skills associated with complex problems

e. Statistical Literacy Ability Level Category

This study uses test question instruments compiled based on statistical literacy indicators and some explanations in the previous sub-chapter. The indicators used in this study were compiled and then adjusted to the criteria and levels of statistical literacy ability as follows:

Table 2. 5 Statistical Literacy Ability Level Category

Aspects	Indicators	Level
Understanding the concept of Statistics	Students can identify what is known and asked in the question	Level 0-1
Analyzing Data	Students can present data in the form of appropriate presentations	Level 2
	Students can apply statistical measurements correctly.	
Interpreting Data	Students can interpret and make conclusions based on the data or diagrams that have been presented.	Level 3
Evaluating Data	Students can make evaluations or criticisms from the data.	Level 4

C. RESEARCH METHODS

1. Type of Research

This research is a Research and Development (R&D) research that aims to collect information about product developments within a certain period. A research method is used to produce or develop products that have been prepared

systematically and can be held accountable. R&D is an effort to create research-based tools or devices. This study's (Ali & Muhammad Asrori, 2014) Research and Development (R&D) model refers to the Borg and Gall development theory by applying preliminary study steps to produce a product as an e-booklet of statistics material based on multiple intelligences.

The R&D model in Borg and Gall's theory in this study includes eight development steps, namely: (1) research, (2) planning, (3) develop a product, (4) field testing, (5) revision of a product, (6) main field testing, (7) final revision, and (8) implementation (Borg & Gall, 2007). The stages of this research can be seen in the following figure:

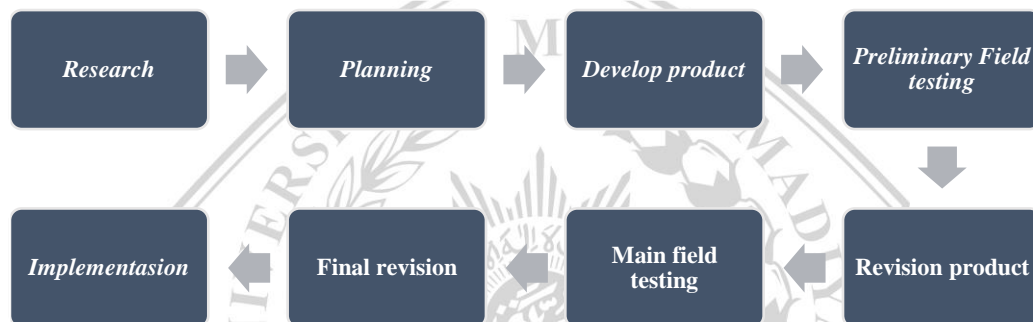


Figure 3. 1 Stages of Research Development

2. Development Procedure

Development procedures are the steps applied in the design to develop or produce a product. This research procedure refers to the development of a Research and Development (R&D) model, according to Borg and Gall. Still, in this study, the researcher only took 8 out of 10 development steps due to the adjustment of the problem formulation. The steps implemented are as follows:

a. Research

In this step, the researcher seeks information about what teachers use learning media, how the tendency of student intelligence is used in the learning process, and students' mathematical abilities, especially in statistical materials. This data was obtained using documentation of exam results, questionnaires for students and interviews with mathematics teachers.

b. Planning

At this stage, the activities are identifying media needs, determining development goals, analyzing materials and curriculum, determining media characteristics, drafting designs and planning trials and evaluations.

c. Develop product

The researcher carried out the initial development process of the e-booklet product based on previous planning regarding the analysis of the material and curriculum, media characteristics and the preparation of the media design (draft) that had been made. The media that has been developed is then validated by media experts and material experts before field trials are carried out.

d. Preliminary Field Testing

In this step, the researcher carried out an initial field trial after the media was declared valid by an expert validator and completed the revisions given. This initial field trial was carried out to determine the readability of the media to ensure that the target users can understand the learning media well. This trial aims to evaluate whether the language, display and presentation of material in the media are to the student's ability.

e. Main Revision Product

In this step, the researcher revised the initial product by the initial field trial results based on initial field trial results based on the identification of low indicator scores and written suggestions given by students in the questionnaire.

f. Main field testing

The implementation of this step aims to determine the effectiveness of the MI e-booklet in improving the level of students' statistical literacy skills. The main field trial involves using the product in the complete learning process. It uses pretest and posttest question instruments based on statistical literacy indicators and the distribution of student response questionnaires.

This trial was carried out at MTsN 4 Banjarmasin with a purposive sampling technique, namely one class of 30 students of grade IX D. The main

field trial used the pre-experimental method of one group pretest-posttest design with the design described as follows:

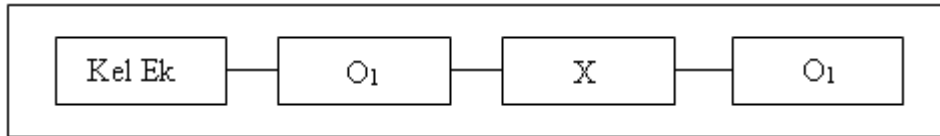


Figure 3. 2 Pre-Experimental One Group Pretest Posttest Design

Information:

Kel Ex = Experimental Group

O1 = Pretest

X = Treatment (Learning Using MI e-Booklet)

O2 = Posttest

Based on this scheme, an initial test (pretest) is provided to determine the initial condition of students' statistical literacy skills. A posttest in this study was carried out to determine the implementation and effectiveness of learning after being given treatment. After obtaining the results of the student test, data analysis is carried out to determine whether there is an increase in students' statistical literacy skills.

g. Final product revision

Improvements to the final product carried out after the main field trial are based on data and things that were still not good at the field trial so that the final product can be produced suitable for use and dissemination.

h. Implementation

This implementation step is the final stage in the development research procedure. Implementation can be done by disseminating the MI e-booklet, so other schools can use it.

The development procedure in this study includes eight stages previously selected based on the needs and formulation of the problems taken in this study. As for making it easier to understand the flow of media development, for this reason, the procedure is described as follows:

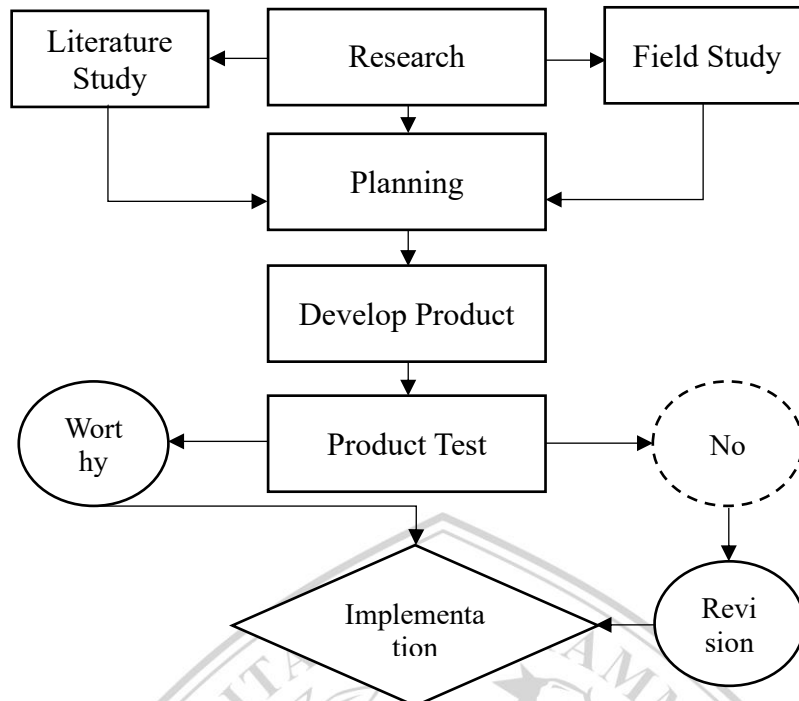


Figure 3. 3 Research Development Procedure

3. Product Testing

Product testing is used to determine the Validity of the MI e-booklet developed and analyze its feasibility and effectiveness so that the product's value and quality can be accounted for. This study tested the product through (1) a media expert test consisting of 2 lecturers, (2) a material test consisting of 1 lecturer and 1 Mathematics teacher, (3) a small group student test (readability) of 10 students and a large group of 30 students (primary field test). The product trial procedure is as follows:

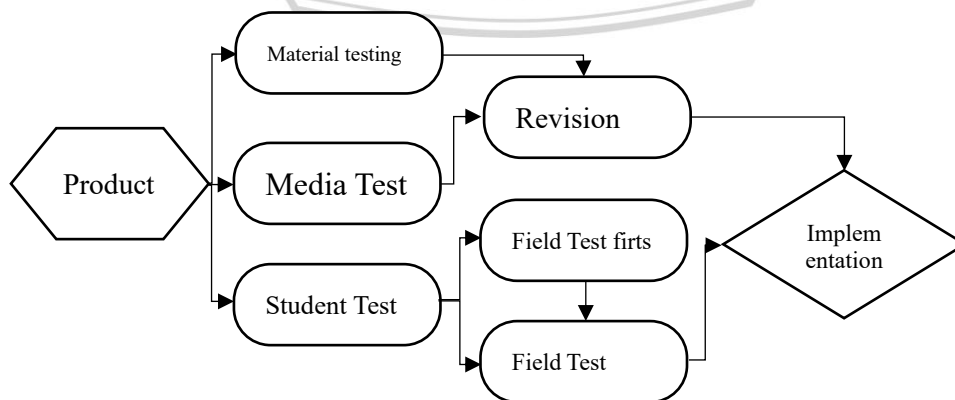


Figure 3. 4 Product Trial Procedure

4. Research Subject

The subject of this study is divided into two parts. The first is the subject of expert validators from among education practitioners, namely teachers and lecturers. The two student subjects come from the population of grade IX students in South Banjarmasin District, Banjarmasin City, with school qualifications that implement the 2013 curriculum and schools accredited in BAN-PDM. The determination of the test subjects in this study used the purposive sampling technique with the following subjects:

- a. The subjects in the product validation test consisted of three lecturers and one mathematics teacher, each from the University of Muhammadiyah Malang, Antasari State Islamic University Banjarmasin and SMPN 2 Mekarsari Barito Kuala.
- b. The initial field trial or small group test (media readability) subjects were grade IX students, totalling 10 from MTs Muhammadiyah 2 Banjarmasin and MTsN 4 Banjarmasin.
- c. The subjects in the main field trial consisted of one class with 30 grade IX students at MTsN 4 Banjarmasin.

5. Types of Research Data

The data used in this study are qualitative and quantitative. Qualitative data is data generated through the interview process, documents from needs analysis, suggestions, notes, corrections, and expert comments written on the rubric that the researcher has provided to test the feasibility of the product that has been produced. Meanwhile, quantitative data was obtained through media expert assessment, material expert assessment, media readability questionnaire, and test questions, which were analyzed using statistical analysis techniques. The results of the quantitative data were used to determine the effectiveness of the MI e-booklet in improving the level of statistical literacy skills.

6. Data Collection Instruments

The data collection instrument in this study was used to collect data from the preliminary, development, and operational test stages. The instruments used in this development research are as follows:

a. Interview

Interviews were conducted with teachers at MTsN 4 Banjarmasin. The interview was conducted to obtain information about problems in the field, teachers' needs for using MI e-booklets, and a grid of interview guidelines for teachers.

Table 3. 1 Teacher Interview Guidelines Grid

No	Indicators
1	Learning process
2	Overview of students' math skills
3	Overview of students' statistical literacy skills
4	Use of media and learning resources
5	The need for MI-based media and learning resources

b. Scale

The scale in this study was used to measure the Validity and e-booklet of MI in terms of structure, technical, appearance, operational, material and benefits by media and material expert validators. This product assessment sheet is compiled using a Likert scale from 1 to 5. The data obtained was then processed using SPSS 26.0 software.

1) Product Assessment Scale by Material Experts

The material expert validation sheet is used to validate teaching materials in terms of construction, technical, and material used in the MI e-booklet to achieve learning objectives. This media expert validation instrument is an adaptation of the research with the following indicators and grids of material expert assessment sheets (Azizah & Iswari, 2021)

Table 3. 2 Indicators and Grids for Material Expert Assessment

Aspects	Indicators	Item No.
Fill	Accuracy of material preparation	1, 2
	Freshness and accuracy of materials	3, 4
	Suitability of media content to material	5
Language	Accuracy of language use	6, 7
	Accuracy of sentence structure	8, 9
	Accuracy of the use of terms (scientific)	10
Serving	Suitability and convenience	11, 12
	Systematics	13,14, 15
	Use of illustrations	16, 17
Sum		17

2) Product Rating Scale by Media Experts

Product assessment by media experts is used to determine the feasibility of the learning media developed for students in the learning process. The instrument used is an adaptation of the research conducted by the following indicators and grids of media expert assessment sheets (Mursali et al., 2024) :

Table 3. 3 Media Expert Rating Indicators and Grids

Aspects	Indicators	Item No.
Display	Design Size of e-booklet	1
	Cover design of the e-booklet	2
	Design the content of the e-booklet	3, 4, 5, 6, 7
Technical Ease	Software Engineering	8, 9
	Compatibility	10, 11
Overall Function	Readability of e-booklets	12, 13
	Visual Design e-booklet	15, 14
	Accuracy of e-booklet content	16, 17
	Interactivity of e-booklets	18, 19
Sum		19

c. Questionnaire

The questionnaire used in this study is divided into 2: the preliminary study questionnaire and the readability questionnaire of the MI e-booklet. The questionnaire in this study uses a Likert scale fill format, namely a response in

the form of a scoring rating of 1 to 5; the categories of the Likert scale used in this study are as follows: (Arikunto, 2021)

Table 3. 4 Likert Scale Categories

Value	Category
5	Very Good/Very High
4	Good/High
3	Good enough/ Enough
2	Poor/Low
1	Bad? Very Low

1) Student Preliminary Study Questionnaire

Before the research, the preliminary study questionnaire examines the problems in the field, learning resources, and intelligence trends students use in the learning process. The indicators and questionnaire grids for the students' preliminary study are as follows:

Table 3. 5 Student Preliminary Study Questionnaire Grid Table

No	Aspects	No. Item
1	Logical-Mathematical intelligence	1, 2
2	Verbal-Linguistic intelligence	3, 4
3	Visual-Spatial intelligence	5, 6
4	Bodily-Kinesthetic intelligence	7, 8
5	Musical-Rhythmic intelligences	9, 10
6	Interpersonal intelligence	11, 12
7	Intrapersonal intelligence	13, 14
8	Naturalist intelligences	15, 16
9	Analysis of the availability of learning resources	17, 18
10	Analysis of student needs	19, 20
11	Use of e-booklets	21, 22, 23
Sum		23

2) MI E-booklet Readability Questionnaire

The MI e-booklet readability questionnaire determines how students can understand the media. The readability questionnaire will be used during the initial field trial given to students. The indicators and grids of the readability

questionnaire are adapted from research conducted with the components presented in the following table (Sarip et al., 2022)

Table 3. 6 Indicators and Grids of the Questionnaire Readability

Aspects	Indicators	Item No.
Material	Easy to understand	1
	Increase knowledge	2
	By KD	3
	Increases interest in learning	4
Language Presentation	Accuracy of language use	5,9
	Suitability of content presentation	6, 7
	Presentation of terminology aids (scientific)	8
Format	Attractiveness of the display	10, 12, 17
	Systematics	11, 15, 16
	Ease of use	13,14
	Sum	17

d. Test

This assessment sheet measures students' statistical literacy skills before (pretest) and after (posttest) the learning process using the MI e-booklet. This test instrument is in the form of questions in the form of essays that are prepared based on statistical literacy indicators adapted from research, which are then adjusted to the core competencies and essential competencies of mathematics subjects in the statistics sub-chapter the size of data centralization and the presentation of grade IX data at the junior high school level. The indicators, instrument grids, scoring guidelines and statistical literacy level criteria for pretest and posttest instruments are as follows (Fadillah & Munandar, 2021; Sharma, 2017; Utomo, 2021)

Table 3. 7 Statistical Literacy Indicators

Aspects	Indicators
Understanding the concept of Statistics	Students can identify what is known and asked in the question.
Analyzing Data	Students can present data in the form of appropriate presentations.
	Students can apply statistical measurements correctly.

Interpreting Data	Students can interpret and make conclusions based on the data or diagrams that have been given.
Evaluating Data	Students can make evaluations or criticisms of the data or information provided.

Table 3. 8 Test Instrument Grid

Statistical Literacy Indicators	Question No.	Sum	
		Pretest	Posttest
Indicator 1			
Indicator 2	Sub Indicator 1		
	Sub Indicator 2	1 and 2	2
Indicator 3			
Indicator 4			
	Sum	2	2

Table 3. 9 Guidelines for Scoring Statistical Literacy Ability Level Tests

Aspects of the Indicator	Student Response to Questions	Score
Understanding the concept of Statistics	Not Providing an Answer	0
	Inability to identify what is known and asked in the question	1
	Able to identify what is known and asked in the question, but there are errors or incomplete.	2
	Able to identify what is known and asked in the question appropriately	3
Analyzing Data	Inability to present data in an appropriate presentation form or apply statistical measurements correctly	1
	Able to present data or apply statistical measurements, but there are errors or incomplete.	2
	Able to present data in the form of appropriate presentation or apply statistical measurements correctly and appropriately	3
Interpreting Data	Inability to interpret and draw conclusions based on the data or diagrams that have been presented	1
	Able to interpret and draw conclusions based on data or diagrams that have been presented but there are errors or incomplete.	2

	Able to interpret and draw conclusions based on data or diagrams that have been presented appropriately	3
Evaluating Data	Unable to evaluate or criticize the data or information provided.	1
	Able to evaluate or criticize the data or information provided, but there are errors or incomplete.	2
	Able to make evaluations or criticisms of the data or information provided appropriately.	3
	Maximum Score	12

Table 3. 10 Criteria and Levels of Statistical Literacy Ability

Criteria for statistical literacy ability	Level
Unable to identify what is known and asked in the question or only able to identify what is known and asked	0 -1 (Informal /Idiosyncratic)
Able to identify what is known and asked in the question, and able to apply statistical measurements or able to present data in the form of appropriate presentation, but unable to interpret and draw conclusions from the data presented	2 (Consistent Non-Critical)
Able to identify what is known and asked in the question, apply statistical measurements or present data in the form of appropriate presentation, and interpret and draw conclusions from the data presented, but unable to make evaluations or criticisms of the data.	3 (Early Critical)
Able to identify what is known and asked in the question, able to apply statistical measurements or able to present data in the form of appropriate presentation, able to interpret and make conclusions, and able to make evaluations or criticisms of the data presented.	4 (Advanced Critical)

The test instrument consists of two questions in the form of essays. It is arranged based on statistical literacy indicators used to see the level of students' statistical literacy skills before (pretest) and after (posttest) the learning process. Because the instrument is the result of development, before being used in data collection, the Validity and reliability of the instrument were first tested on 15 grade IX students.

Based on the analysis using SPSS 26.0 software, the results were obtained that the Validity of the two questions tested was in the valid category or the results of the analysis met the validity criteria, namely using significance. The test results are described as follows: $r_{hitung} > r_{tabel}$ $\alpha = 0,05$ ($r_{tabel} = 0,4124$)

Table 3. 11 Validity of Test Instruments

Item Number	Coefficient	Criterion
1	0,7333	Valid
2	0,8077	Valid

Reliability is the instrument's consistency; if given to the same subject, even though it is given to different people, times, and places, it will give relatively the same results. The reliability of the instrument in this study is determined based on the criteria according to Guilford in the following Table :

Table 3. 12 Test Instrument Reliability Criteria

Correlation Coefficient	Criterion	Reliability Interpretation
$0,90 \leq r \leq 1,00$	Very High	Very fixed/Excellent
$0,70 \leq r < 0,90$	Tall	Fixed/Good
$0,40 \leq r < 0,70$	Keep	It is pretty fixed/Good enough
$0,20 \leq r < 0,40$	Low	Non-permanent/Poor
$r < 0,20$	Very Low	Very unusual/Very bad

The reliability test used determines values based on Cronbach's alpha rule, with the provision that if it is at the level of significance, it can be concluded that the question item is reliable. Based on the test output in the $r_{xy} > r_{tabel}$ $\alpha = 5\%$ SPSS 26.0 software, it shows that the question instrument obtained a score of 0.792 with the category "High", which means that the question items can be said to be reliable and can be used in collecting research data.

Table 3. 13 Test Instrument Reliability

Reliability Statistics	
Cronbach's Alpha	N of Items
.792	2

7. Data Analysis Techniques

The data analysis aims to find the research results in the form of the Validity and effectiveness of the MI e-booklet. The following will describe the data analysis carried out in detail in this study.

a. Data Analysis Preliminary Study

Preliminary study data is in the form of documentation on student test scores, records of interview results, and questionnaires on the availability of learning resources and intelligence tendencies possessed by students. Documentation and interview data were analyzed using the data triangulation method based on field results and related library source data. Meanwhile, the questionnaire data is processed by calculating the Percentage of each item selection by calculating the number of respondents divided by the number of respondents multiplied by 100%, with the formula stated (Sudjana, 2001) by the following:

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

Information:

P = Percentage of respondents' choice of answers

f = Many respondents

N = Total Number of respondents.

b. Analysis of Validity Data of MI E-Booklet

The distribution of product assessment generated the validity date of the MI e-booklet by assigning a score on a scale of 1-5 obtained from 4 expert validators. The data is then analyzed quantitatively by calculating the content validity score based on the following methods (Aiken, 1985)

$$V = \frac{\sum s}{n(c - 1)}$$

Information:

V = Validity Score

s = r - lo

n = Number of validators.

Lo = The lowest validity rating number (in this case = 1).

c = Highest validity rating (in this case = 4)

r = Numbers given with Media validity criteria (Oktariyanti et al., 2021)

The Interpretation Criteria for expert validator test scores obtained from calculations are then converted using the following criteria (Einstein et al., 2022)

Table 3. 14 Validity Criteria of MI E-booklet

Validity Score	Criterion
$80 < V \leq 1.00$	Very High
$0,60 < V \leq 0,80$	Tall
$0,40 < V \leq 0,60$	Keep
$0,20 < V \leq 0,40$	Low
$0.00 < V \leq 0.20$	Very Low

c. Data Analysis of the Effectiveness of MI E-Booklet

Data on the effectiveness of the MI e-booklet was obtained from the results of the initial field trial and the primary field test, namely in the form of a student readability questionnaire and the test results (pretest-posttest) of the students' statistical ability level. The analysis of questionnaire data obtained at this stage was analyzed quantitatively with guidelines adapted from the following table (Mardapi, 2008)

Table 3. 15 Criteria for the Effectiveness of the MI E-booklet

Score Interval	Category
$X > Xi + 1,8 Sbi$	Excellent
$Xi + 0,6 Sbi < X < Xi + 1,8 Sbi$	Good
$Xi - 0,6 Sbi < X < Xi + 0,6 Sbi$	Pretty Good
$Xi - 1,8 Sbi < X < Xi - 0,6 Sbi$	Not Good
$X < Xi - 1,8 Sbi$	Bad

Information:

Xi = Mean/average ideal score = $1/2$ (maximum score + minimum score)

Sbi = Ideal standard deviation = $1/6$ (maximum score-minimum score)

X = Score obtained

Inferential analysis was also carried out to see the effectiveness of the MI e-booklet in improving students' statistical literacy skills, as seen from the

results before and after using the MI e-booklet incomplete learning. The tests carried out were data prerequisite tests, which included normality and homogeneity tests of data, then continued with concluding paired sample t-tests and N-gain tests. The elaboration of the test carried out before the conclusion of media effectiveness is as follows:

1) Data Normality Test

The normality test aims to determine the distribution of data to be used in the research. Suitable data for use in research is data that has a normal distribution. The normality test was carried out on the pretest results and posttest data. The normality test was conducted using the Shapiro Wilk software SPSS 26.0 program. The decision criterion used to declare customarily distributed data is if the significance value $.> \alpha = 0,05$

2) Data Homogeneity Test

The homogeneity test was carried out to determine whether the research subjects came from a homogeneous population. Homogeneity tests were carried out based on the pretest and posttest results. The Levene Statistic software SPSS 26.0 program facilitates the calculation of this homogeneity test. The decision criterion used to state homogeneous data is if the significance value $.> \alpha = 0,05$

3) Paired Sample t-Test

This paired sample t-test compares the average increase in the level of statistical literacy skills of students before and after treatment in the experimental class. The Paired Sample t-test was conducted using SPSS 26.0 software with a significance level of 5%. The decision criteria used to declare H_0 are rejected if the significance value so that $H_1 > \alpha = 0,05$ is accepted with the following hypothesis formulation:

H_0 : There was no significant difference in students' statistical literacy skills between the pretest and posttest in the experimental class.

H_1 : There was a significant difference in students' statistical literacy skills between the pretest and posttest in the experimental class.

4) N-gain test

The N-Gain test is used to measure the effectiveness of the use of MI e-booklets in improving students' statistical literacy skills and to state the acquisition scores in several categories. The categories used are based on the following descriptions (Meltzer, 2002)

Table 3. 16 Effectiveness Level of MI E-booklet

N-gain	Criterion
$0,7 \leq N - \text{gain} \leq 1$	Tall
$0,3 \leq N - \text{gain} < 0,7$	Keep
$N - \text{gain} < 0,3$	Low

D. RESEARCH RESULTS

1. Description of MI E-Booklet Development

a. Research

The MI e-booklet was developed based on an initial study conducted in two Madrasahs in South Banjarmasin District, Banjarmasin City, namely MTs Muhammadiyah Banjarmasin and MTsN 4 Banjarmasin. The findings of the field study that were successfully collected were in the form of data obtained through interviews and the distribution of questionnaires aimed at grade IX students. In addition, a literature study is also carried out to determine the ideal conditions that can support research.

1) Literature Study

This study's literature was carried out by collecting and studying books, journals, survey results, research reports, and media containing information related to MI e-booklets and statistical literacy skills. This is done to be the basis for sufficient understanding to conduct research and develop MI e-booklets for Madrasah Tsanawiyah/Junior High School on statistics subject matter. Furthermore, a more detailed and supportive literature review has been discussed in Chapter II.

2) Field Studies

The field study carried out was a needs analysis through the distribution of questionnaires and interviews aimed at grade IX students and mathematics teachers from two different schools. The following is an explanation of the needs analysis.

a) Student Questionnaire

The questionnaire was given to grade IX students at MTs Muhammadiyah 2 Banjarmasin and MTsN 4 Banjarmasin on May 1 and 3, 2024. The questions addressed to students consisted of 11 aspects and 23 questions about learning media, the need for MI learning resources and the tendency of students' learning intelligence. The results of the questionnaire were obtained as follows:

Table 4. 1 Results of the Initial Study Questionnaire

It	Aspects	Percentage
1	Logical-Mathematical intelligence	78%
2	Verbal-Linguistic intelligence	55%
3	Visual-Spatial intelligence	47%
4	Bodily-Kinesthetic intelligence	23%
5	Musical-Rhythmic intelligences	44%
6	Interpersonal intelligence	53%
7	Intrapersonal intelligence	65%
8	Naturalist intelligences	20%
9	Analysis of the availability of learning resources	60%
10	Analysis of student needs	71%
11	Use of MI e-booklet	11%

The results of a questionnaire from 20 students of MTs Muhammadiyah 2 Banjarmasin and MTsN 4 Banjarmasin showed that most of the students agreed that learning media can help provide meaningful insights and learning but had never used e-booklets based on multiple intelligences.

b) Interview

Based on the results of the interview of the primary resource person, a mathematics teacher who teaches grade IX, it is known that the learning process is carried out using a variety of methods, such as direct

and group learning and projects. The school provides several learning resources, but there is no media specifically made to be used in statistical materials, and there is no media based on MI. The resource person said that one of the reasons for the absence of media in the form of MI e-booklets is due to the lack of reading resources or knowledge related to the matter and also the unavailability of facilities and infrastructure that can be used by teachers (GM interview. Sya. May 1, 2024).

The interview activity also explored information related to students' mathematical skills and statistical literacy. Statistics material in the 2013 curriculum is taught in the even semester of grade VIII, and the position of the statistics chapter is in the final chapters, so some discussions of the material are missed, and the delivery is not optimal. This was also justified by the source, who said:

"I am not so in-depth in teaching this statistical material because the material is in the final chapter, so only a few sub-chapters can be taught (GM Statement. Sya. May 1, 2024)."

In addition, based on the personal experience of researchers who teach at MTs Muhammadiyah 2 Banjarmasin. Students' mathematical abilities when given exercises during the learning process are often different from those during exams. At the time of practice, almost all students showed good understanding, but at the time of the exam, many of them could not give the correct answer, and it happened to nearly all materials, including statistics.

"The results of the analysis of the mathematics exam, especially on the student statistics material, show that of the 5 questions tested, only an average of 20% of students were able to answer correctly (GM Statement. Aa. May 1, 2024)."

The use of media that is not optimal and the limitations of teachers in developing learning media are also conveyed by teachers from the results of interviews. Learning media can help students be active in learning, and I use it as much as possible to take advantage of what is available. However, it is still rare because they often use teacher and LKS-

supporting books directly. If I were asked to make a learning medium, I could do it, but I was constrained by the time taken up by many student assessments (GM interview. Sya. May 1, 2024).

b. Planning

1) Identify Media Needs

The review results are based on findings that using e-booklet media based on multiple intelligences has never been used. The statistical literacy ability of students in both research sites is still relatively low. One of the factors that caused the low score was the unavailability of adequate facilities and infrastructure and the delivery of statistical material, which was considered not optimal because it was at the end of the chapter. For this reason, researchers develop media that can be used in situations that occur in the field.

2) Development Objectives

Based on the results of the preliminary study and the identification of media needs, the researcher formulated the research objectives, namely to develop media in the form of e-booklets on statistical materials that can facilitate the domain of students' intelligences (multiple intelligences) and are valid and effective in increasing the level of students' statistical literacy. The developed e-booklet has at least "high" validity and shows good effectiveness from the results of media readability and student response, has a good effectiveness value of N-gain and answers the hypothesis of statistical testing during field trials.

3) Material and Curriculum Analysis

The material in the e-booklet is class VIII statistics material at the MTs/SMP level, which includes two subjects, namely the measure of data concentration (mean, median and mode) and the presentation of data with diagrams (bars, circles and lines). The indicators for the preparation of e-booklets that are adjusted to the provisions of the curriculum and aspects of statistical literacy ability are: (1) students can understand how to determine and evaluate the measure of data concentration (mean, median, mode), (2) students can understand how to present data on a problem/event and (3) students can

provide a critical evaluation of data or information. The description of the preparation of the material content in its entirety includes information content about statistics and statistical materials in schools, multiple intelligences and core sub-materials, which are prepared in the format of 6 dominant intelligences found in the preliminary study.

4) Determining the Innovation Aspects of the MI E-Booklet

Some aspects of innovation carried out to compile learning media in the form of E-booklets can be seen in the following Table 4.2:

Table 4. 2 Innovation Aspects of MI E-Booklet

Asepek	Conventional E-Bookle	E-Booklet MI
Approach	Focusing on a one-type approach to intelligence	Integrating the theory of Multiple intelligences.
Design and content	The content is more descriptive text or direct explanation without much variation.	The content is designed with various interactive variations and group and independent activities.
Flexibility	Suitable for specific learning styles, such as auditory or visual only	Accommodating a variety of student learning styles
Supporting media	It is a static document with no additional interactive features.	It comes with interactive media, such as images, videos and links
Main Purpose	Convey the material in general without targeting specific goals.	Helping students develop their statistical literacy skills

5) Determining the Specifications of the MI E-Booklet

Based on the planning steps that have been explained earlier, the researcher determines the specifications of the appearance, form, material and technical e-booklet that will be developed as follows:

- Heading : Statistics E-Booklet (Based on Multiple Intelligence)
"MI E-Booklet"
- Media Type : Electronic Booklet,
- Application : Canva
- Size : A4 (21 cm x 29.7 cm)

- Material : Statistics (data centralization and data presentation measures)
- Ladder : MTs/Junior High School Class VIII
- Format of Contents : 6 intelligences (musical, logical-mathematical, linguistic) visuals spatial, interpersonal and intrapersonal)
- Website : YouTube, Google Sheets and Suno
- Operational : Active button.

6) Creation of MI E-booklet Design Concept

Based on the specifications of the e-booklet that the researcher has determined, a design concept was made which includes four parts of the main page, namely the cover, table of contents, concept map and the content of the material which can be seen in the following image;

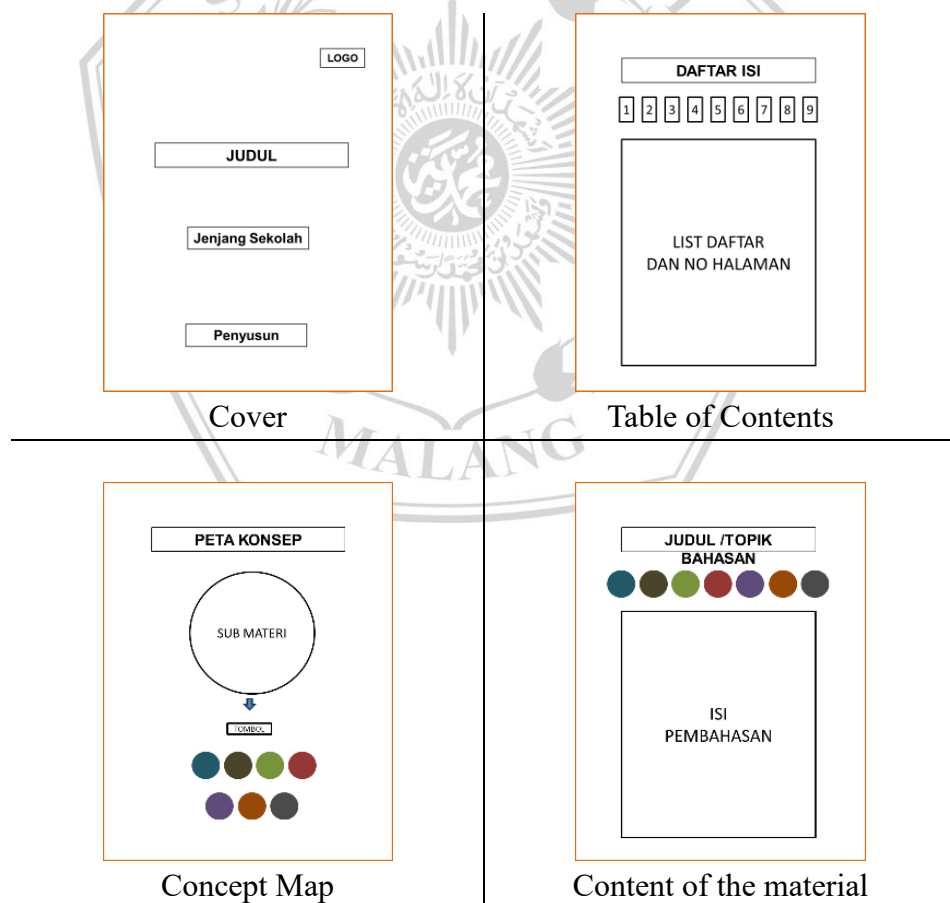


Figure 4. 1 MI E-Booklet Design Concept

c. Develop Product

The researcher develops the MI e-booklet based on the steps in the research plan with a predetermined concept design. The elaboration of the development and final design, which includes the cover page, table of contents, concept map, material content and cover of the MI e-booklet, has been validated by experts and revised with the following results:

1) Cover Page

The cover page contains information such as the title of the e-booklet, user level, logo, illustration image, compiler name, and related agencies. The final design of the e-booklet cover is as follows:



Figure 4. 2 Final Design of the Cover of the MI E-Booklet

The table of contents page contains a list of titles for each page, starting from the cover, table of contents, concept maps, statistical concepts and definitions, and material in the format of 6 intelligence and quizzes (evaluation). This page is also designed with buttons that make it easier for users to go to the desired page in order or randomly.



Daftar Isi

PETA KONSEP

- Cover
- Daftar Isi
- Peta Konsep

1 2 3

- Apakah Itu Statistik?
- Mengenal Multiple Intelligence
- Tentang E-Booklet

4

- Mengenal apa itu Data
- Bentuk Data
- Diagram Batang dan Lingkaran
- Makna Statistik di Sekolah

5 6

- Bagaimana Mengolah Data Kuantitatif
- Mengumpulkan Data
- Mereduksi Data
- Mempersembahkan Data

7 8

- Mengumpulkan Informasi Dari Data Kuantitatif
- Identifikasi Kurang Pemusatan Data
- Menuliskan Kesimpulan
- Memberikan Tanggapan Kritis

9 10 11

- Mengolah Data Kuantitatif Menggunakan Aplikasi
- Mengahami Data Kuantitatif dengan Media Sosial
- Mengahami Data Kuantitatif Dengan Visualisasi

12 13 14

- Kuis

15

Figure 4. 3 Final Design of the MI e-Booklet Table of Contents

2) Concept Map Page

The concept map page displays the material in the e-booklet and contains several icons indicating that the material is packaged in several intelligence concepts. These icons also function as buttons that make it easier for users to go to the desired page in order or randomization and return to the main page.



Figure 4. 4 Final Design of MI E-Booklet Concept Map

3) Content Page Based on MI

The content page of the material is designed with six MI formats, some of which are logically mathematic and linguistic, intrapersonal and interpersonal formats, and visual and musical formats. Each page has several buttons that make it easier for users to go to the desired page in

order or randomly and return to the main page, as well as links to YouTube videos, suno websites and spreadsheet websites.

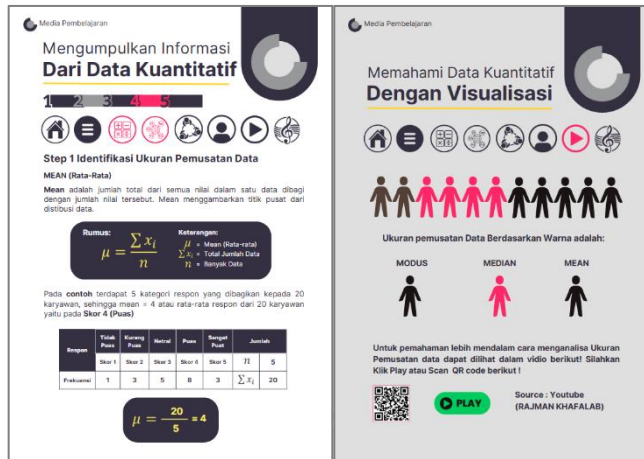


Figure 4. 5 Final Design of MI E-Booklet Materials

4) Quiz Page

The quiz page contains two questions in the form of descriptions that have been adjusted to statistical literacy indicators. This question can be used as a final learning exercise or as a material for group study. The quiz design is as follows:

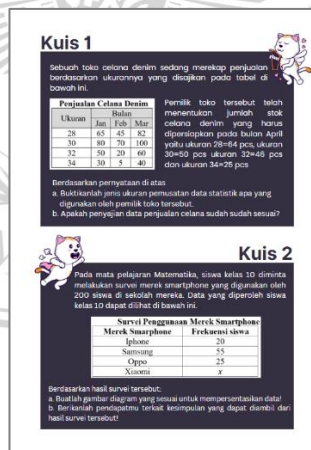


Figure 4. 6 Final Design of the MI E-Booklet Quiz

5) Closing Page

The closing page contains thanks and some information from the compiler of the e-booklet, which aims to convey further information, as well as suggestions and improvements for improving the MI e-booklet. The quiz design is as follows:

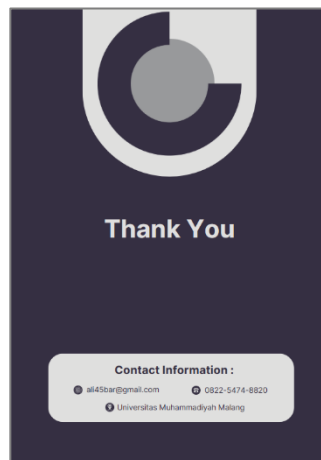


Figure 4. 7 Final Design of MI E-Booklet Cover

6) Validity of the MI E-booklet

According to experts, the MI e-booklet Validation Test aims to see the validity of the material and design. The e-booklet validation test was carried out by showing MI e-booklet media to validators, material experts, and media experts along with their assessment sheets in a scale format with a range of 1-5. The data obtained was then analyzed using Aiken's method to present the validity of the MI e-booklet from both material and media experts. The elaboration of the product validation results with the following results:

a) Material Expert Validation

Product validation by material experts is carried out to see the feasibility of the material in the MI e-booklet. The first validator is a Doctoral and certified lecturer in the mathematics education study program. The second validator is a mathematics teacher certified in teacher education. The summary of the validity results of Aiken's from the two validators can be seen in the following table:

Table 4. 3 Material Expert Validation Results

Aspects	Percentage	Score Validity	Criterion
Contents/Materials	84%	0,80	Tall
Language	88%	0,85	Very High
Serving	86%	0,82	Very High
Average	86%	0,82	Very High

Based on the validity of the score from the assessment of the subject matter experts in the table above, it can be seen that the material on the MI e-booklet media has an average score of 0.82 with Aiken's criteria which is very high or very valid and has a percentage of 86%.

b) Media Expert Validation

Media experts validate product validation to see the feasibility of the appearance, technical convenience, and overall functionality of the MI e-booklet—TwoI e-booklet media at different levels of higher education. The first validated the MI e-booklet media. The first validator is a certified lecturer named Professor, who teaches in the postgraduate program. In contrast, the second validator is an accredited lecturer with a Master of Mathematics Education degree who teaches in the undergraduate program. The summary of the validation results of the two media expert validators can be seen in the following table:

Table 4. 4 Media Expert Validation Results

Aspects	Percentage	Score Validity	Criterion
Display	93%	0,91	Very High
Technical Ease	85%	0,81	Very High
Overall Function	95%	0,94	Very High
Average	91%	0,89	Very High

Based on the results of product validation by media experts, in terms of technical convenience, the overall appearance and function are at very high or very valid criteria. With these results, MI e-booklet media is valid in content and suitable for learning.

The initial product testing in this study is to test the validity of the MI e-booklet materially and medically by experts. The following is a summary of validity testing using Aiken's method converted to the average percentage shown in the following diagram:

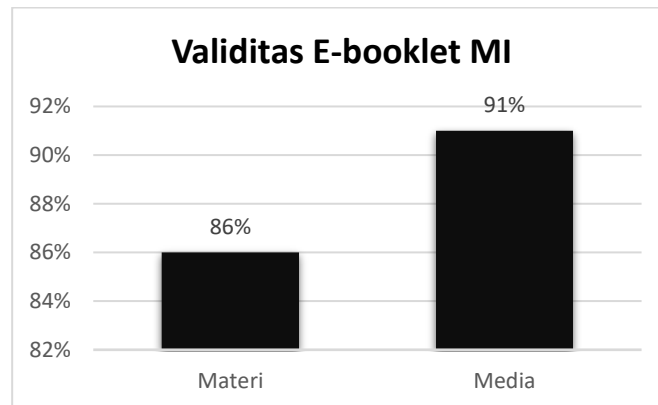


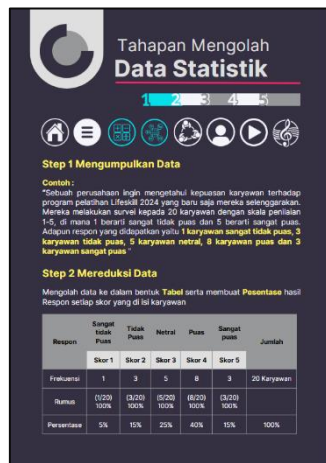
Figure 4. 8 Percentage of Validity of MI E-Booklet

7) Revision of MI E-booklet Expert Validator

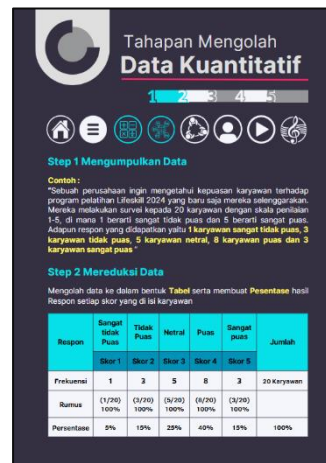
During the validation process by material and media experts, the MI e-booklet product was also revised. In addition to assessing the product, the second also provides input and suggestions for product development. Based on suggestions and inputs, there are revisions to several parts of the product, including the following:

a) Revision of Word Usage

The revision of the use of words suggested by media and material expert validators is in the form of replacing the use of words that are easy to understand and do not cause double perception, such as in the title "Stages of processing statistical data" it is clarified the type of data to be obtained so that the title is changed to "Stages of processing quantitative data". Then, there are some corrections to the wrong words in the writing. The following is a display of media before and after the researcher revised it.



Before the Revision

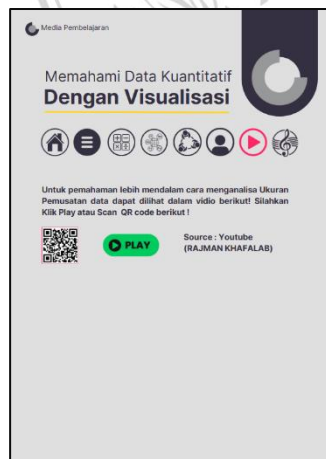


After the Revision

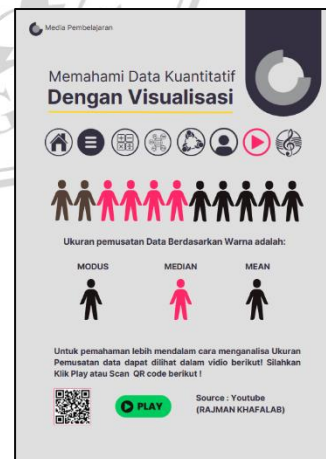
Figure 4. 9 Revision of the Use of Words in the MI E-Booklet

b) Revision of the material section

Revision of several parts of the material in the first part, about what materials will be discussed in the booklet and the addition of material in the statistical literacy ability level section on page 7. Then, the revision of the material in the visual intelligence format section, which initially only contained videos that could be clicked and directed students to YouTube videos, became an additional visual illustration, as seen in the following image:



Before the Revision

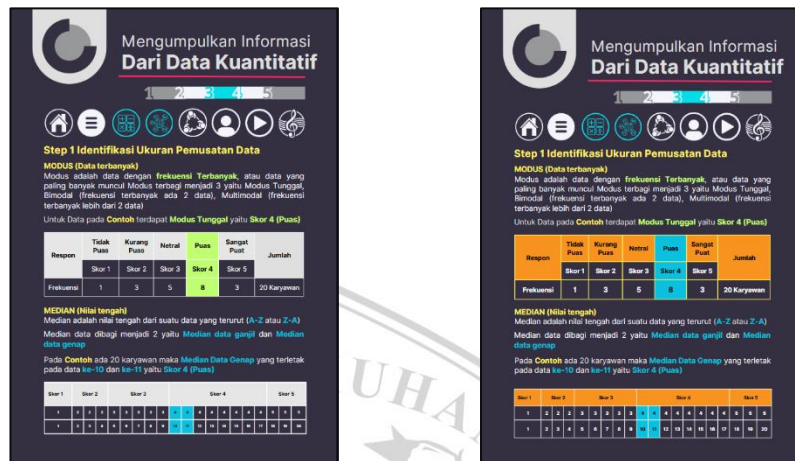


After the Revision

Figure 4. 10 Revision of the MI E-Booklet Material Section

c) Revision of the Table Color Section

The revision of this part of the table is based on suggestions from media experts, namely that the display has a colour contrasting with the design. The results of the revision are as follows:



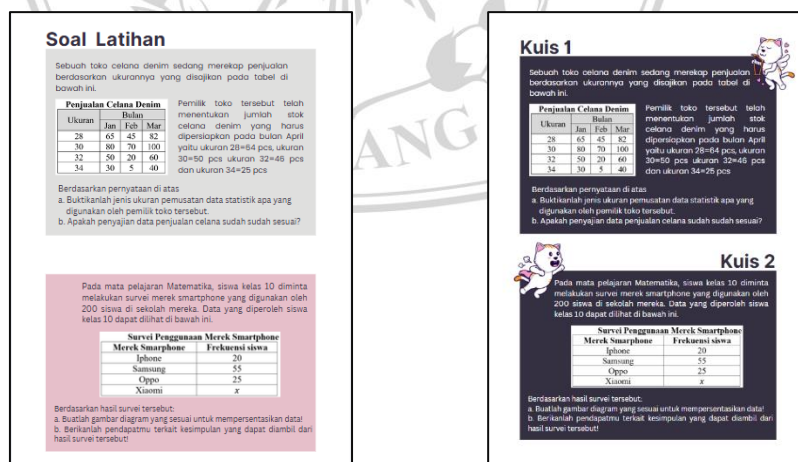
Before the Revision

After the Revision

Figure 4.11 Revision of the Tile Color Section of the MI E-Booklet

d) Revision of the Evaluation Section

The revision of this evaluation section includes a design that was initially still unattractive and the use of contrasting fonts and colours that make it difficult to read. Revise the final display as follows:

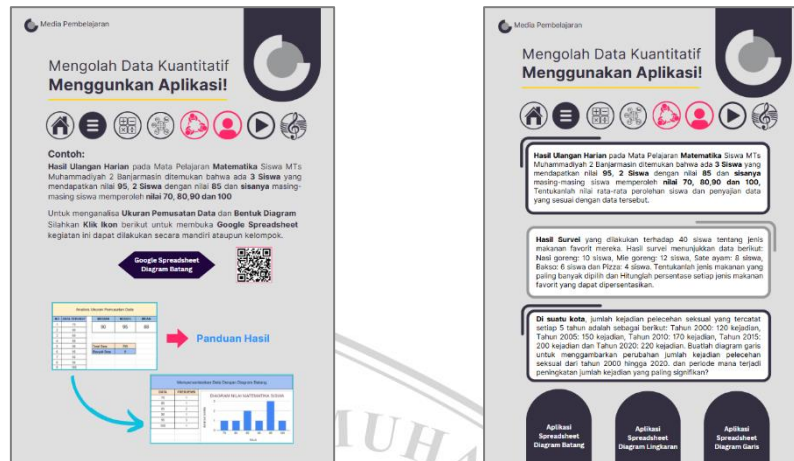


Before the Revision

After the Revision

Figure 4.12 Revision of the Evaluation Section of the MI E-Booklet

The improvement suggestion from the teacher is to add to the material related to the presentation of data with a spreadsheet so that it can also be presented in the form of pie and line diagrams.



Before the Revision

After the Revision

Figure 4.13 Revision of e-booklet by teacher

d. Preliminary Field Testing

Media readability testing aims to measure the extent to which text, images, or other elements in the media can be understood, read, and accessed by students. Therefore, limited media testing was conducted for grade IX students totalling 10 at MTs Muhammadiyah 2 Banjarmasin and MTsN 4 Banjarmasin on November 12, 2024. The trial was carried out by displaying the MI e-booklet and inviting students to try to operate and assess the e-booklet through a questionnaire with content evaluated in terms of material, language presentation and format. The summary of the results of the student questionnaire is described as follows:

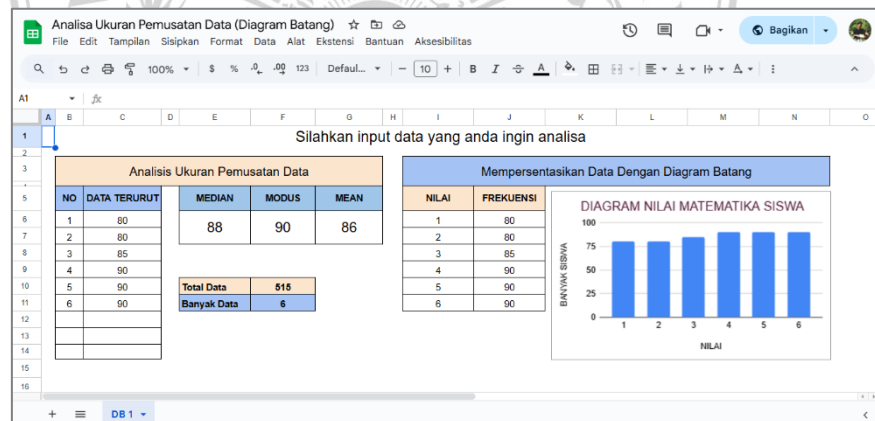
Table 4.5 Results of the readability of the MI e-Booklet

Aspects	Percentage	Score	Criterion
Material	82%	0,78	Good
Language Presentation	78%	0,72	Good
Format	84%	0,80	Excellent
Average	81%	0,76	Good

Based on the table of the results of the readability of the MI e-booklet by students, it was found that the format aspect received a score of 0.76 with high criteria, and the material element and language presentation were at the high criteria. With these results, the average readability of MI e-booklet media by students is at a high criterion, which means that the media can be understood well by students.

e. Main Revision Product

At the media readability test stage, suggestions and comments were obtained from students. The students' recommendations for improvement are improvements to the links and spreadsheet formats so that they can be accessed independently and do not overlap with others. The revision was to improve the spreadsheet format, which initially only used one sheet, which was difficult if all students accessed it together. Therefore, sheets were added as many as the number of students so that spreadsheets could be used independently, and the sheet number was adjusted to the number of the student attendance list.



Images Before Revision

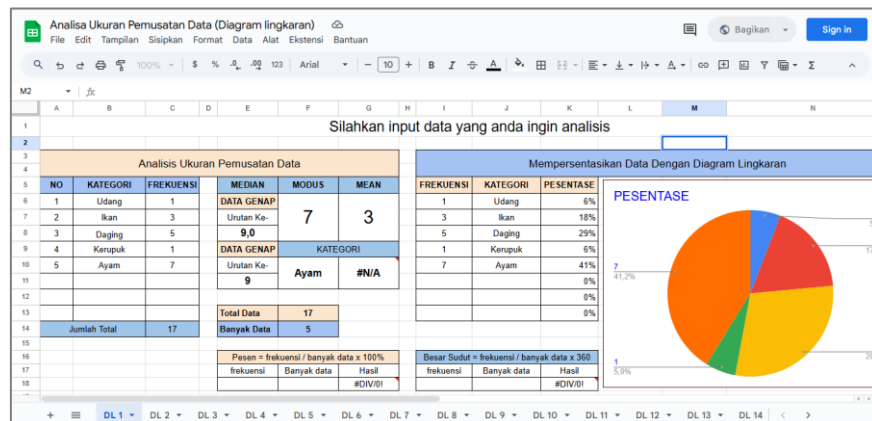


Image After Revision

Figure 4. 14 Revision of MI E-Booklet Spreadsheet Format

f. Main field Testing

The main field trial was carried out using the pre-experimental one-group pretest-posttest design method, which was carried out with one experimental class by providing a pretest to see the initial ability of students' statistical literacy before being treated, in this case, learning using MI e-booklet media then providing a posttest to see the final ability, whether there is an improvement in statistical literacy ability or not so that it can determine the effectiveness of the media. The main field trial was carried out after the MI e-booklet media went through the revision stage on the suggestions obtained from the initial field trial.

The main field trial was carried out on November 15, 2024, at MTsN 4 Banjarmasin to 30 students in class IX D. The data obtained in the form of answers to pretest and posttest questions that students did were then analyzed quantitatively using several data tests, namely the normality test and the homogeneity test as a prerequisite test, then continued with the paired sample test, the T-test looked at the significance and answered the previously formulated research hypothesis, and conducted the N-gain test to see the effectiveness criteria. The results of the test are described as follows:

1) Inferential Statistics of Test Scores

a) Data Normality Test

The Normality Test is used to see whether the pretest and posttest data are typically distributed. The criteria for testing normality based on the Shapiro-Wilk method are that if the data of this study is significant, the data can be declared normally distributed. The significance values obtained from the $> 0,05$ pretest and posttest results are 0.149 and 0.80, respectively, which means that the value is greater than the significant value, so it is concluded that the data is usually distributed.

Table 4. 6 Data Normality Results

Variable	Shapiro-Wilk		
	Statistics	Df	Sig.
Value Pretest	.948	30	.149
Posttest	.938	30	.080

a. Lilliefors Significance Correction

b) Data Homogeneity Test

The homogeneity test was carried out to see if the data was homogeneous. The decision-making criteria are if the value of significance is homogeneous. Based on the test results, the results were obtained that significance value can be stated that the $0,050,065 > 0,05$ pretest and posttest values taken as homogeneous data.

Table 4. 7 Data Homogeneity Test Results

	Levene Statistic	df1	DF2	Sig.
Value Based on Mean	3.511	1	58	.066
Based on Median	3.087	1	58	.084
Based on the Median and with adjusted df	3.087	1	56.972	.084
Based on trimmed mean	3.526	1	58	.065

c) Paired Sample T-test

After the data is declared to be normally distributed and homogeneous, the test continues to see the effectiveness of the use of e-booklets and whether there are significant differences before and after

learning to use e-booklets from students' statistical understanding. The results of the paired sample t-test are as follows:

Table 4. 8 Paired Sample T-test Test Results

	Mean	Std. Deviation	Std. Error	95% Confidence Interval of the Difference		t	Df	Sig. (2-tailed)
				Lower	Upper			
Pretest - Posttest	-3.933	1.437	.262	-4.470	-3.397	-14.994	29	.000

Based on Table 4.7, the results of the paired sample t-test obtained a value of Sig. (2-tailed) smaller than the significant level ($0.00 < 0.05$), H_0 is rejected. In other words, a substantial difference exists between the pretest value (before using the MI e-booklet) and the posttest value (after using the MI e-booklet).

d) N-gain test

The N-gain test was conducted to see the effectiveness of increasing statistical literacy skills before and after using the MI e-booklet. The test results showed that the N-gain pretest and posttest scores were 0.52, which means that the difference in scores when using e-booklets was in the moderate category and was quite effective in increasing the level of students' statistical literacy skills by 52.29%. The test results are shown in the following table.

Table 4. 9 N-gain Test Results

	N	Minimum	Maximum	Mean	Std. Deviation
Ngain_skor	30	.20	1.00	.5230	.23769
Ngain_person	30	20.00	100.00	52.2991	23.76863
Valid N (listwise)	30				

g. Final product revision

At this stage, the researcher made the final revision obtained from the researcher's observations during the expert validation process and field trials, namely in the form of adding a summary of the central part or content packaged

on one page with a QR code format and the addition of a brief bio from the compiler to add originality to the MI e-booklet. The revision is in the form of adding content as follows:



Gambar 4. 15 Addition of Biodata and Summary of MI E-Booklet Content

h. Implementation

This implementation step is the final stage in the development research procedure. Implementation can be done by disseminating so that other schools can use it. In this step, the researcher chose to implement the MI e-booklet in a limited way, namely by providing free access to the Canva link and the MI e-booklet in the form of a softcopy file at the school where the research was conducted.

2. Description of Statistical Literacy Ability Level

The level of statistical ability was obtained based on the test results given before learning (pretest) and after learning (posttest) with questions in the form of descriptions on 30 grade IX MTsN 4 Banjarmasin students. The following describes the student's ability level based on the test given.

a. Descriptive Statistics of Test Results

The values described in this section are the results of the pretest and posttest in the form of working on a question in the form of a description with four statistical literacy indicators, which, if students answer the question, will get a score range of 0 – 12. The questions used in the pretest differ from those used in the posttest but have the same load of indicators and scoring. The data

analysis described in this section uses the help of the SPSS 26.0 application. The results of the study are as follows:

Table 4. 10 Descriptive Statistics of Pretest and Posttest Scores

Descriptives		LS Pretest Score		LS Posttest Scores	
		Statistic	Std. Error	Statistic	Std. Error
Mean		3.93	.349	7.87	.457
95% Confidence Interval for Mean	Lower Bound	3.22		6.93	
	Upper Bound	4.65		8.80	
5% Trimmed Mean		3.89		7.85	
Median		3.50		8.00	
Variance		3.651		6.257	
Std. Deviation		1.911		2.501	
Minimum		1		4	
Maximum		8		12	
Range		7		8	
Interquartile Range		3		4	
Skewness		.292	.427	.134	.427
Kurtosis		-.747	.833	-1.178	.833

The data in the table above shows that the minimum and maximum scores obtained by students in the pretest and posttest have increased significantly. In the pretest score, the student is only in the score range; in the 1 – 4 posttest score, it increases until it reaches the upper limit of the score range, namely 8 – 12. The average pretest score also increased significantly, from the original value of 3.93 to 7.87, which means an average score of almost 100%.

b. Students' Statistical Literacy Ability Levels

Students' statistical literacy skills are divided into four levels proposed by Sharma: level 0-1 Informal/Idiosyncratic, level 2 Consistent Non-Critical, level 3 Early Critical and level 4 Advanced Critical. This level of statistical literacy ability is obtained from the results of student work through a test in the form of a description mapped based on statistical literacy indicators adjusted to competency standards in statistical materials. The literacy level in this study

was obtained from the pretest before learning using the MI e-booklet and the posttest after the learning was carried out.

The achievement of the level of statistical literacy ability was first analyzed using the pretest questions given before learning using MI e-booklet media. The pretest is given before learning begins by asking students to work on a question in the form of a description with a time of 10 minutes. The tabulating results of the achievement of statistical literacy levels in the pretest are answered as follows:

Table 4. 11 Tabulation of Students' Statistical Literacy Levels in Pretest

Level	Information	Number of Students	Percentage
0-1	Informal/Idiosyncratic	15	50%
2	Consistent Non-Critical	12	40%
3	Early Critical	3	10%
4	Advanced Critical	0	0%
Sum		30	100%

Based on the table, it is known that 50% of students are only able to do pretest questions at levels 0-1 (Informal/Idiosyncratic). In other words, students cannot identify what is known and asked in the question or can only determine what is known and asked intuitively. The pretest results also illustrate that students' highest achievement level only occupies level 3 (Early Critical), and no student has reached level 4 (Advanced Critical), where students entirely give critical answers to the statistical literacy pretest questions.

The second student's statistical literacy level achievement can be seen in the posttest conducted after learning e-booklets. This result is also a benchmark for whether there is an increase in the level that occurs after learning. The posttest is carried out by providing one question that is different from the pretest question and has the same format, namely the description. The posttest results are described in the following table:

Table 4. 12 Tabulation of Students' Statistical Literacy Levels on Posttest

Level	Information	Number of Students	Percentage
0-1	Informal/Idiosyncratic	0	0%
2	Consistent Non-Critical	11	37%
3	Early Critical	10	33%
4	Advanced Critical	9	30%
Sum		30	100%

The table shows that the average percentage of three levels of statistical literacy, namely level 2 Consistent Non-Critical, level 3 Early Critical and level 4 Advanced Critical reaches 30%. This result indicates that although there is no dominance of the highest level achievement, in the posttest, no more students are at the 0-1 level, and most have experienced significant improvements.

The following is a comparison of the achievement of students' statistical literacy skills when given pretest and posttest questions after learning the MI e-booklet.

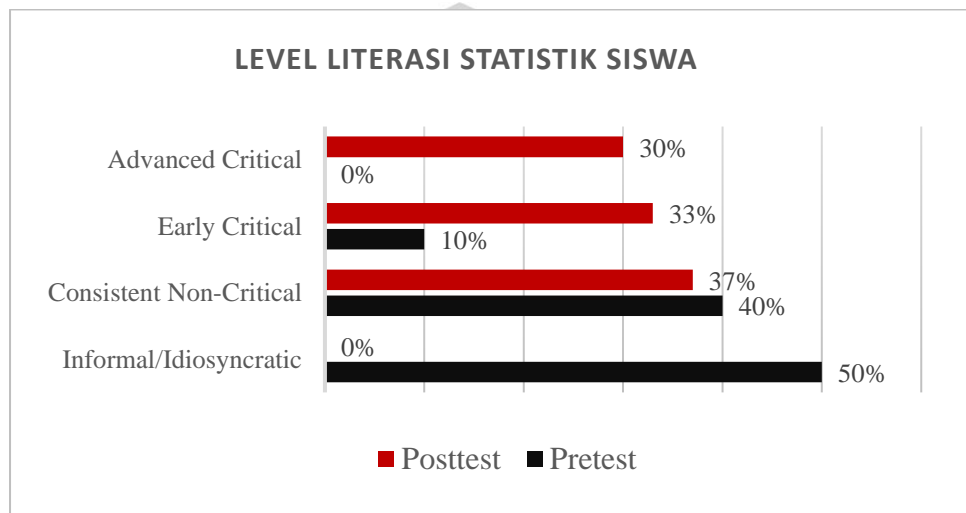


Figure 4. 16 Results of the Student Statistical Literacy Level Test

E. DISCUSSION

1. Validity of MI E-Booklet

The validity assessment with Aiken's method shows that the e-booklet based on multiple intelligences (MI) meets the validity criteria in a very high category. This means that the quality of media and content in terms of content, language, presentation, display, technical ease and overall function of the e-booklet is to the principles of MI-based learning. Based on the validity score obtained, the MI e-booklet can be applied in the learning process as an effective tool.

These results align with research that media designed with MI principles offers many ways to master the necessary knowledge and skills. The research is the

development of a mathematics (Davis et al., 2011; El Hikam & Malasari, 2023) e-module with a realistic mathematic education approach based on the theory of multiple intelligences that meets the criteria of valid and practical as a learning resource. Then, the study (Destari et al., 2022) also found that MI-based learning tools effectively improve learning outcomes. However, not all studies show positive results, such as finding no significant difference in students' understanding of mathematical concepts when using multiple intelligence approaches (McGraw Jr, 1997). direct learning with simple media was more effective in improving learning outcomes. Therefore, although the resulting MI e-booklet can be used in the learning process, it is necessary to consider several factors that affect its effectiveness (Rosmi, 2017; Sudarmin et al., 2018).

Some of the implications of these findings are that MI e-booklets can be integrated into the curriculum to support more engaging statistical learning. Making learning inclusive by providing opportunities for students with diverse learning styles to achieve the same competencies and encouraging the development of similar MI-based media for other subjects. The limitations of the research are that the creation of MI-based media requires a longer time than conventional media, and the implementation of MI-based e-booklets requires adequate digital devices, which may not be available in all schools.

2. Effectiveness of MI E-Booklet

The results showed that e-booklets based on Multiple intelligences (MI) effectively increased students' statistical literacy skills, as indicated by an N-gain value of 0.52 or an increase of 52.29%, with a moderate effectiveness category. These results suggest that the MI-based approach can accommodate various learning styles from students' dominant intelligences, thus helping students understand statistical concepts better. In addition, good readability in small groups showed that the presentation of language, materials and e-booklet formats successfully attracted students' attention and facilitated more effective learning. $P\text{-value} < \text{Sig. (2-tailed)}$ It also strengthens the significant differences in statistical literacy skills before and after using MI e-booklets, confirming that MI e-booklets can be a learning medium that supports the group and independent learning process.

The results of this study are related to the research conducted, namely, producing mobile-based media that is significant in increasing the level of students' statistical literacy. Then, research on developing teaching materials based on (Bilgin, 2021; Rasyid et al., 2020) multiple intelligences with effective results in improving critical thinking skills. Several similar studies were also conducted by those who studied (Asinta & Prasetyaningtyas, 2021; Destari et al., 2022; Ismail & Jamil, 2019; Khabibah et al., 2020; Kusuma Ardi Wijaya et al., 2022; Setyowati, 2021) multiple intelligences-based media and came to the conclusion that the quality of learning is more effective in improving learning outcomes and student learning motivation. Studies with different results conclude that although (De Mello et al., 2024) the multiple intelligences approach can enhance the learning experience, some challenges still make the relevance of specific learning contexts ineffective.

The results of this study have several practical and theoretical implications. The implication for practitioners is that teachers can use multiple intelligences-based e-booklets as an alternative learning medium to improve students' statistical literacy, especially in the digital era. Meanwhile, this study strengthens the theory of multiple intelligences as a foundation for designing adaptive and effective learning media. This also opens up opportunities for further development of numerous intelligences-based learning media on other broader topics.

Some research limitations need to be considered, such as a limited sample size of one class. Although it gets good results, it is necessary to generalize them widely. Then, the scope of this research only focuses on statistical literacy. Hence, the application of MI e-booklets in other fields of mathematics needs to be further explored, and the duration of MI e-booklets may affect the results. Therefore, long-term studies are required to evaluate the impact of using this medium on an ongoing basis.

F. CONCLUSIONS AND SUGGESTIONS

1. Conclusion

Based on the analysis of the research data that has been carried out, the researcher wrote several conclusions of the research results described as follows:

- a. The generated multiple intelligence-based statistics e-booklet (MI e-booklet) was declared valid by media experts with a very high category and valid according to material experts with a very high category
- b. MI e-booklets are effective in improving the level of students' statistical literacy skills. Because it has good readability in small group field tests and obtained a category that is quite effective in large group field trials.

2. Suggestion

Based on the conclusions of the research results described above, the researcher also wrote some suggestions for teachers, students and advanced researchers as follows:

- a. For teachers, it is hoped that they can use this MI e-booklet as an alternative to active learning using technology that can facilitate dominant intelligence in increasing the level of students' statistical literacy skills and is expected to be able to share this experience with colleagues in one profession.
- b. For students, it is expected to always learn and love mathematics and not close themselves to using technology, especially in learning statistics, because the material is very closely related to daily life, about how we interpret a data or information that is very fast and easy for us to get in today's age.
- c. For advanced researchers, it is hoped that the results of the development of this MI e-booklet can be applied in project-based learning and can explore a wider variety of bound variables and use materials that are still considered difficult for students.

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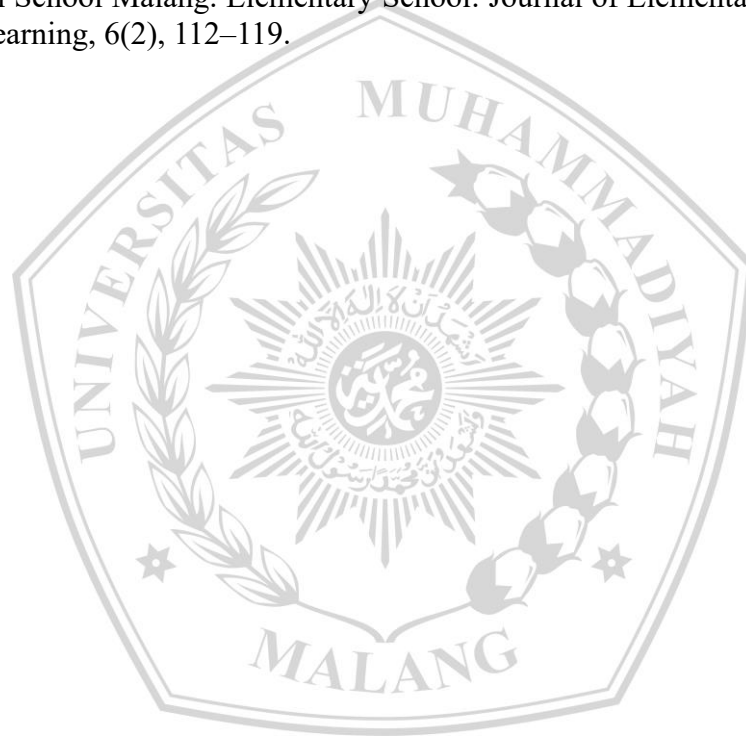
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ATTACHMENT

Appendix 1. Results of the Development of MI E-booklet

The MI e-booklet developed in this study can be accessed on the Qr-code and the following link:

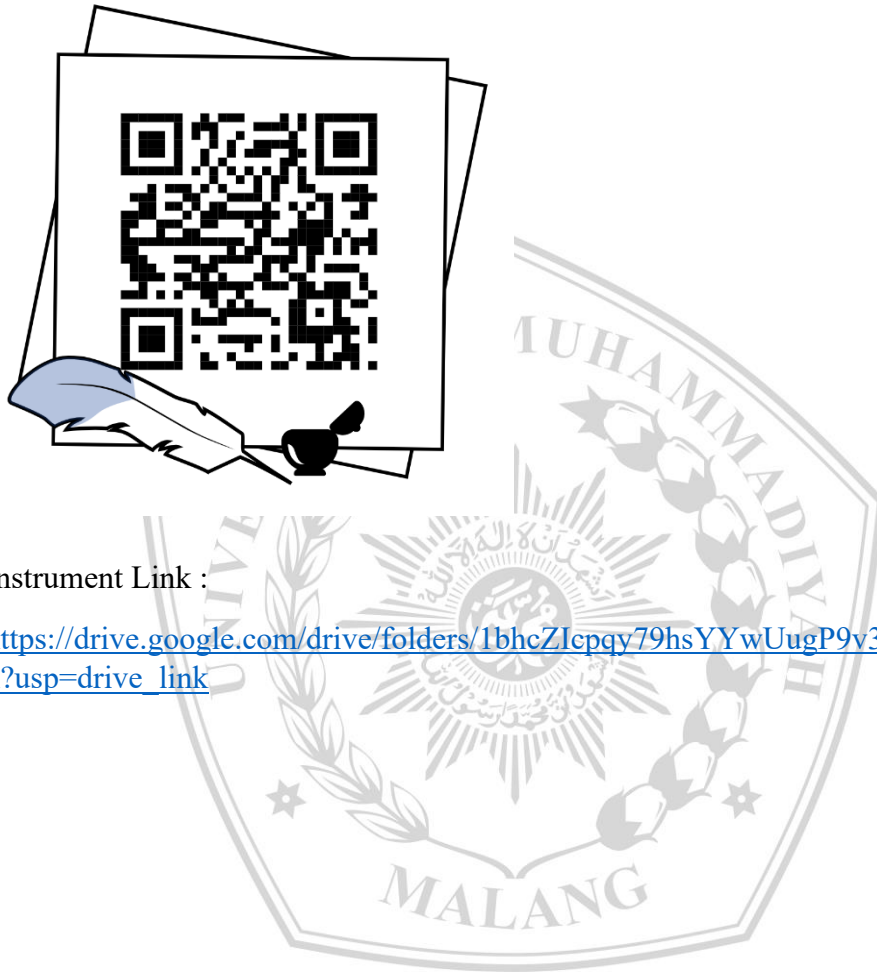


E-Booklet Link:

https://www.canva.com/design/DAGbSrjqUU/hmq494uFx60t7UdUNUdQRQ/edit?utm_content=DAGbSrjqUU&utm_campaign=designshare&utm_medium=link2&utm_source=sharebutton

Appendix 2. Research Instruments

The research instruments are in the form of interview guidelines, questionnaires, assessment sheets and test questions. The instrument can be seen on the Qr-code and the following link



Instrument Link :

https://drive.google.com/drive/folders/1bhcZlcpqy79hsYYwUugP9v3QCuLrmoHx?usp=drive_link

Appendix 3. Research Data

The research data is in the form of tabulation of interview results, questionnaires, product assessment results and answers to test results and research administration. The data can be seen on the following QR code and link



Research Data Link

https://drive.google.com/drive/folders/10nRmKZHlyh5sj2XkrT65iRiPLj7eOeA9?usp=drive_link



Appendix 4. Documentation



Appendix 5. Author Bio

BIODATA



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 4. Antasari State Islamic University Banjarmasin 2016-2021
Mathematics Education Study Program
 5. University of Muhammadiyah Malang 2023-2025
Master of Mathematics Education Study Program
-

Family List :

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Mother : Hasnah
Sibling : 1. Nur Paidah
2. Suwandi
3. Nur Paridah
4. Rudi Nur
5. Wahidah
6. Muhammad Iqbal
7. Muhammad Baim

Malang, January 03, 2025

Ali Akbar