DEVELOPING STUDENT ASTRONOMY MATEMATICS BOOKS USING 4D MODELS (DEFINE, DESIGN, DEVELOP, DISSEMINATE)

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Abstrak : Student Books are designed to facilitate students in gaining meaningful learning experiences. This research is development research. The product developed in this research is a Student Book so that it meets the criteria for validity, practicality and effectiveness. The Student Book was developed using Thiagarajan's 4-D development model. which includes four stages, namely definition, design, development and distribution. The results of this research show the practicality of the Student Book in terms of 1) The response of the expert or validator team which states that the Student Book can be used with minor revisions 2) The implementation of the Student Book is at the high IO = 4.35 criteria. The average validity of student books is 4.28, in the valid category. Effectiveness is viewed from 1) Classical completeness 2) The teacher's ability to manage learning 3) Achievement of the ideal percentage of student activity time. 4) Response of students who get good results.

Keywords: Student Books, 4D

Introduction

In Government Regulation Number 13 of 2015, it is explained that student books/textbooks are the main learning source for achieving Basic Competencies and Core Competencies. Student books are used to increase efficiency and effectiveness, the number of which is adjusted to the needs of students. The Ministry of Education and Culture (2013) explains that: Student Books are books intended for students which are used as a guide to learning activities to make it easier for students to master certain competencies. This explains that the Student Book is not just reading material, but is also used to carry out activities in the learning process (activities based learning). The contents are designed and equipped with examples of activity sheets with the aim of enabling contextual learning, meaning that students can learn something. that are relevant to the life he experiences.

Student Books are designed to facilitate students in gaining meaningful learning experiences. The content of the book is directed at making students more active in participating in the learning process through observing, asking questions, reasoning, trying, discussing and improving their communication skills both between friends and with their teacher. Through these activities, it is hoped that students will be able to foster motivation, curiosity, initiative and creativity. Even though it has been arranged in such a way, teachers can still develop or enrich other materials and activities that are in accordance with the learning objectives that have been set.

The Ministry of National Education (2008) stated that "A book will usually contain something that is the brainchild of an author. "If a teacher prepares a book to be used as teaching material, his thoughts must be derived from the KD contained in the curriculum, so that the book will provide meaning as teaching material for the students who study it."

Furthermore, it is explained in the Ministry of National Education (2008) that "A book will start from the background of the writing, definition/understanding of the title stated, explanation of the scope of discussion in the book, laws or rules discussed, examples needed, research results, data and its interpretation, various appropriate arguments to be presented".

Furthermore, in the Ministry of National Education (2008) it is said that the steps that can be taken by a teacher in writing a book are as follows: a. Studying the curriculum by analyzing it b. Determine the title of the book to be written in accordance with the SK that will be provided for the book. c. Design a book outline so that the book's contents are complete and cover all aspects needed to achieve a competency. d. Collect references as writing material, try to use references that are current and relevant to the study material. e. Writing a book is done by paying attention to the presentation of sentences that are adapted to the age and experience of the reader. For high school students, try to make sentences that are not too long, a maximum of 25 words per sentence and in one paragraph 3 – 7 sentences. f. Evaluate/edit written results by re-reading. If there is a shortage, add it immediately. g. Improve writing. h. Use various learning sources that can enrich the material, for example books, magazines, the internet, research journals.

Furthermore, the Ministry of Education and Culture (2013) explains the role and function of the Student Book which can be detailed as follows:

a. Guide for Students in Carrying Out Learning Activities.

Each sub-theme in each book has several lessons according to the theme discussed consisting of various activities that must be carried out by students, for example; observing something, in the book it is written "Let's Observe" meaning the teacher invites students to observe something, it could be a picture or film show, or the surrounding environment. The storytelling activity in the book says "Let's Tell" means that the teacher invites students to tell something, perhaps telling about the results of observations of something or telling about experiences they have had. Carrying out activities, in the book it is written "Let's do it" means the teacher invites students to carry out an activity, students must carry out activities to get to know friends in their class. Apart from that, students are also required to introduce themselves in front of the class.

b. Liaison between Teachers, Schools and Parents

In every lesson there are parts that must be done by parents in order to guide children to carry out learning activities at home.

c. Student Activity Sheet

The Student Book can function as a student activity sheet, for example in the Student Book. In the first problem, students are asked to observe the picture and complete the table that has been provided according to the instructions given, namely filling in the formula according to Trigonometric ratios. Students do not have to copy the picture in a notebook, but can do it on the page as a student activity sheet.

d. Learning Steps Scenario

Teachers can use the Student Book to carry out learning steps. On each page of the Student Book, in the top left corner or top right corner, there are icons of activities carried out by students in the learning process such as "Let's do it", "Let's sing", "Let's be creative", "Let's tell stories", activities it can be used as a sequence or steps in learning activities.

e. Students who can be Used in Assessment

Teachers can use the Student Book to carry out learning steps. On each page of the Student Book, in the top left corner or top right corner, there are icons of activities carried out by students in the learning process such as "Let's do it", "Let's sing", "Let's be creative", "Let's tell stories", activities it can be used as a sequence or steps in learning activities.

f. Communication Media between Teachers and Students

Through the learning process using Student Books, teachers can get to know students better through observing the results of student work which has been designed in such a way in each lesson. Teachers can see the development of students' knowledge, skills and attitudes in accordance with the learning competencies that have been determined.

g. As a memento of student learning track records

All the results of the work carried out by students during the learning process will be contained in the Student Book, so that teachers and parents can see traces of learning and competency development during the learning process at each level. For students, all of these learning records are useful as keepsakes for the future.Dari uraian di atas, penulis menyimpulkan bahwa buku siswa memuat judul buku, kata pengantar, daftar isi, deskripsi buku, informasi kompetensi isi, kompetensi dasar, dan indikator yang sesuai dengan topik eksponen, memuat peta konsep, materi pembelajaran terdiri dari (pangkat bulat positif, pangkat bulat negatif, dan bentuk akar), kesimpulan setiap submateri, rangkuman, latihan soal, evaluasi, dan rubrik penilaian *self efficacy* siswa, dan pembahasanpada setiap submateri dijelaskan sesuai dengan indikator penalaran matematis.

Literature Review

Akker (1999) states that validity in development research includes content validity and construct validity which reads "validity refers to the extent that the design of the intervention is based on state-of-the art knowledge ('content validity') and that the various components of the intervention are consistently linked to each other ('construct validity'). The statement states that validity refers to the extent to which the design of a device is based on the current state of technology, art or science ('content validity') and the various components of the device are consistently related to each other ('construct validity').

According to Nieveen (1999), a material is said to be of quality if it fulfills quality aspects, including: (1) validity, (2) practicality, (3) effectiveness. Validity, meaning validity, is the nature of being true according to existing evidence, which is said to be valid if what is made measures what it should measure. Validation in research includes content validation and construct validation.

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Akker (1999) states that practicality in development research is related to: "practically refers to the extent that users (or other experts) consider the intervention as appealing and

usable in 'normal' conditions.". This means that practicality refers to the degree that users (or other experts) consider the intervention to be usable and preferable under normal conditions.

In Reigeluth's (1999) opinion, the most important aspect of effectiveness is to know the level or degree of application of a theory or model in a particular situation.

The effectiveness of a learning tool can be measured from the effectiveness of implementing learning in the field. According to Eggen & Kauchak (1988) Effective Teaching occurs when students are actively involved in organizing and finding relationships in the information they encounter rather than being the passive recipients of teacher-delivered bodies of knowledge. This activity results not only in increased learning and retention of content but also in improved thinking skills.

The quote above implies that effective learning occurs when students are actively involved in organizing and finding relationships with the information provided. Students do not just passively receive the knowledge conveyed by the teacher but they can respond actively. The results of this activity not only increase students' understanding and absorption of learning material but also involve thinking skills.

Method

This research is development research. The product developed in this research is a Student Book so that it meets the criteria for validity, practicality and effectiveness. The Student Book was developed using Thiagarajan's 4-D development model. which includes four stages, namely definition, design, development and distribution. Each stage is carried out continuously.

In the process of developing Student Books, which are useful for obtaining valid, practical and effective Student Books, several activities are carried out such as validation, revision and trial using the Student Books that have been developed as well as instruments as measuring tools for Student Books with predetermined rules and criteria.

The instruments used to evaluate student books based on the problem-based learning model developed are observation sheets and assessment scales which aim to see whether each indicator that appears in the student book is in accordance with the provisions or not and to see the validation of the instruments developed. The student book instrument grid is as follows:

Tabel 1 Student Book Validation Sheet Grid

Rated aspect	Indicator	Observation Items
Format	- Clarity of distribution of material	1
	- Has attraction	1
	- Clear Numbering System	1
	- Conformity between text and illustrations	1
	- Space arrangement/layout	1
	- Appropriate font type and size	1
	- Suitability between the physical book and the student	1
Language	- Grammatical correctness	1
	- Suitability of sentences to students' level of thinking and reading ability and age	1
	- Encourage interest in reading	1

	- Clarity of instructions/directions	1
	- The communicative nature of the language used	1
Illustration	- Illustration support to clarify concepts	1
	- Provides visual stimulation	1
	- Has a clear display	1
	- Easy to understand	1
	- Using local context	1
Contents	- The truth of the content/material	1
	- Is an essential material	1
	- Grouped into logical sections	1
	- Conformity with competency standards	1
	- Compatibility with problem-based learning	1
	- Suitability of material sequence	1
	- Eligibility as a Student Book	1
Total		**25**

Based on the results of observations and assessments given to the instrument by experts/experts, content validity will be determined. The validation determined for the student books used is seen from the results of the agreement of 5 experts/experts in the field of mathematics education, so that the use of student books at the trial stage that has been developed has been effective.

Result and Discussion

Definition Stage (Define)
The book used by students is a book published by the Ministry of Education and Culture, published in 2016. This book does not use media-based learning in its learning which can improve students' mathematical problem solving abilities and self-efficacy.

Design Stage (design)
Student books are prepared so that students have guidance in understanding the lesson material in accordance with the set learning objectives. The student book developed contains contextual problems that must be solved in groups and independently. Next, in each subchapter the problems are presented. Then in each subchapter examples of questions are given along with alternative answers to increase students' understanding in solving problems and competency test questions are given based on students' mathematical problem solving abilities.
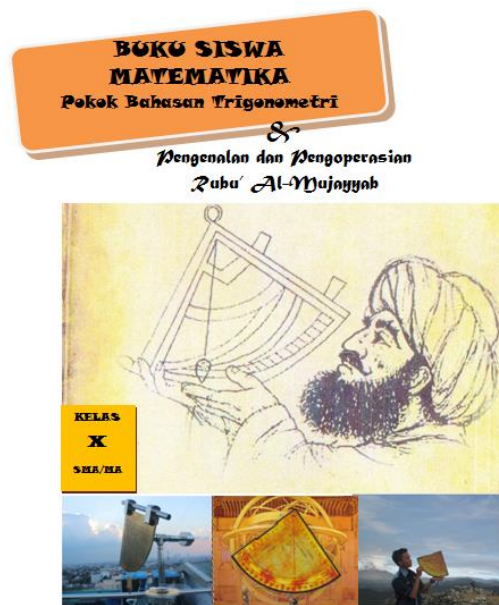
Gambar 1. Cover Buku Siswa

This book was prepared as a student's guide to studying high school/MA level mathematics. As an introduction, this book also contains how to use problem-based learning,

Development Stage (Develop)

The initial draft produced was validated by experts. The results of expert validation in the form of corrections and suggestions are used as a basis for making improvements to the Student Book. The revised Student Book based on input from validators is called Draft-I.

Based on the results of validation calculations by 5 experts on the Student Book (BS) contained in attachment 8. The average score for the format aspect is 4; language aspect 4; illustration aspect 4 and content aspect 4.25. So from the calculation results, the average value for all validators is 4.28. Furthermore, the validation results from this expert team are referred to the validity criteria established in chapter III. So referring to these criteria, it can be concluded that the Student Book (BS) developed meets the validity criteria in the "Valid" category.

However, in this validation process there are several things that must be corrected based on the notes provided by the expert team, including improving typing and using appropriate illustrations. Repairs to student books are the same as repairs to teacher books.

Dissemination Stage (Disseminate)

After valid and effective criteria are met in trial II, the final device (final draft) is obtained. The next step is to carry out limited distribution in the form of distributing the final tools to the MGMP forum at Madrasah Aliyah Muhammadiyah 1 Medan which is marked by handing over Student Books to the MGMP forum with the hope that mathematics teachers who are members of the forum can apply these learning tools in their next lessons. The main step after submitting the final device is to submit the results of the development to the entire population in this study.

Conclusion

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References

Akker, J.V.D. 1999. Principles and Methods of Development Research. Dalam Plomp, T; Nieveen, N; Gustafson, K; Branch, R.M; dan van den Akker, J (eds). *Design Approaches and Tools in Education and Training.* London: Kluwer Academic Publisher.

Depdiknas. 2003. *Media Pembelajaran*. Jakarta: Depdiknas.

Depdiknas. 2008. *Panduan Pengembangan Bahan Ajar.* Direktorat Pembinaan Sekolah Menengah Atas.

Kemendikbud. 2013. *Panduan Teknis Memahami Buku Siswa dan Buku Guru di Sekolah Dasar.* Jakarta: Direktorat Jenderal Pendididkan Dasar dan Direktorat pembinaan sekolah dasar.

Nieveen, N. 1999. Prototyping to Reach Product Quality. Dalam Plomp, T; Nieveen, N; Gustafson, K; Branch, R.M; dan van den Akker, J (eds). *Design Approaches and Tools in Education and Training.* London: Kluwer Academic Publisher.

Reigeluth, C.M. 1999. *Instructional-Design Theories and Models Volume II: A New Paradigm of Instructional Theory*. New Jersey: Lawrence Erlbaum Associates Publishers.

Thiagarajan, S., Semmel, Ds., Semmel, M. 1974. *Intructional Development For Training Teachers Of Exceptional Children*. A Source Book Blomingtn, Central For Innovation On Tesching The Handicapped.