The Development of High School Physics Textbooks Based on Batak Culture

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Abstract. The purpose of this study is to develop High School physics Textbook based on Batak Culture with valid, practical and effective categories. This study is Research and Development (R&D) using 4-D models covering the define, design, develop, and stages disseminate. Physics Textbook developed in the form of teacher’s book, student’s books, study test results. Batak Cultural aspects are integrated into the phases of the Cooperative Learning Model. The student discussion activities were conducted with batak cultural interaction pattern, namely Dalihan Natolu as batak socio-cultural system in solving problems raised from batak cultural illustration. Validity criteria were obtained through expert assessment of Textbook, practicality and effectiveness obtained through small group trials and limited class trials. The subjects in the study were students of grade XI MIA I SMA Negeri 1 Kotanopan. The results showed that High School Physics Textbook based on Batak Culture have met valid, practical and effective criteria.

1. Introduction
The development of students' ability in Physics subjects is the way to improve students' ability to adjust by changing times to enter the world of technology at this time. The teachers should be able to present physics subjects with the right concept and use the right learning model to make learning process work properly and enjoyable. Text-book is also important in the learning process. Learning model that teacher use should be aligned with the Text-book to be used. Learning resources organized through a design that is used as a teaching resource can be beneficial for teacher and student. Text-book is in accordance with learning model an important for learning can be useful and achieve its goals [1].

Based on the observations is held on the school, the teacher of physics obtained information that in terms of facilities of SMA Negeri 1 Kotanopan school does not have enough facilities, both from the laboratory and the use of Text-books. The use of Text-books that is currently as a teacher’s book in teaching still incompatible with the application of cooperative learning models. Books commonly used and applied by teachers are books from publishers that are the content of book only the theory and the task. So the students consider physics subject is difficult because the books contain formulas such as math. Various problems in physics learning lead to low student learning outcomes.

The importance of Text-books should synergistic and in accordance with the learning model expect to increase learning outcomes. The text-books that still not in accordance with learning model also become a factor of learning process that occurs in the classroom. The use of text-books that still centered on a teacher will reduces student activity. Through the use of text-books that are in accordance with learning will guide students in solving problems and changing students' paradigms for
the better. Paradigms in education really need to be adapted to changes that occur such as not just equipping students with mastery of facts and formulas but need to empower students to face and overcome complex and non-routine cognitive challenges [2].

Text-books must be developed based on daily life in order to be meaningful to students and in accordance with the level of intellectual. Text-books can be developed by integrating culture into the problems present to students. Cultural integration is done to get problems close to the students' daily life. Physics is very closely related to culture, especially in Indonesia with rich culture, so this integration not only creates meaningful and interesting physics learning also preserves the nation's culture and build good character for students [3]. Therefore physics is open ended because it always develops following the changing patterns of dynamics in society [4]. But in reality, physics text-books still lack of based culture that teachers can use.

The Developing of teaching Text-books based on local culture can be used as one of solution to create a contextual and meaningful learning process for students. The culture that will be integrated into Text-books must conform to the culture that students have. Choosing Batak culture in North Sumatra can be supporting learning process to emerge students' interest in learning physics. Many things can be developed from Batak culture, both in learning and exemplify the values that exist in Batak culture.

Culture is a knowledge possessed by a group of people, relate to their behavior. Text-books which integrated with culture can involve students to maintain the cultural identity of students in the face of globalization [5]. So it is necessary to develop physics Text-books based on Batak culture as a solution in order to create a contextual and meaningful learning process for students.

Through the development of Text-books Batak culture, students will be understand and construct their knowledge contextually. Because, the subjects will be directly related to the students’ daily life related to cultural elements both value, moral and concrete. In addition, by developing Text-books Batak culture, it not only has a positive impact on active learning but also introduced Batak culture itself and will maintain the sustainability of local wisdom values.

Regarding research and development it has been conducted by previous researchers such as [6] obtained the conclusion that the development of Batak culture-based learning tools is able to improve generic skills and student cooperation. In research conclude that students' generic science and self-learning skills improved by implementing the development of Malay culture-based learning tools [7].

Research with titled "Development of teaching materials and Assessment Ternatif online subjects for grade 8 Junior High School with Dick and Carey models". In the results of his research obtained the conclusion that online and alternative assessment materials online effectively improve learning achievement in Junior High School grade 8 in the second semester [8]. In addition, research on the development of teaching materials entitled "Development of teaching materials in the form of student worksheets (LKS) based on problem solving (problem solving) in the set material for grade VII junior high school". The results obtained in the study are the use of LKS that has been developed to provide motivation to learn and assist students in learning on the set material [9].

Research with titled "Development of Mathematical Learning Model Based on Batak Culture Based Problem (PBM-B3)" shows that the application of PBM-B3 Model in the implementation of learning in the classroom can stimulate the cultural experience that students have in solving problems [10]. Students can build their own way of solving problems using their logic and social experience.

Physics texts-books are developed with a cooperative learning model based on Batak culture starting with a stimulus in the form of problems designed by teachers, the problems raised are associated with contextual that is derived from student culture. It means to make the students feel that the subjects is a part of them that does not come suddenly.
2. Method
This research is Research and Development (R&D) by using 4-D Models. 4-D models covering 4 stages namely define, design, develop, and disseminate. The research was held until the develop stage due to the limitations of researchers. The products are teacher books, and student books. The subjects in this research were students grade XI MIA I SMA Negeri 1 Kotanopan academic year 2019/2020, and the object of this research is the development of Physics text-books based on Batak culture.

Instruments were validation sheets used to examine the validity of text-book, student response observation sheets used to examine the practicality of text-book and learning test. Qualitative data in this research was obtained from assessment and revision until the product is produced in the form of physics text-book based on Batak culture and quantitative data in the form of student learning scores.

3. Result and Discussion
The results of the research development on each stage can be described as follows:

3.1 Stage Define
The define stage is performed with the aim of establishing and defining the requirements need in learning process. This define stage consists of front-end analysis, learner analysis, concept analysis, task analysis, and specifying instructional objectives.

Data collection was conducted at this stage through observations and interviews with physics teachers and students at SMAN 1 Kotanopan. The observations showed the low quality of text-books used in SMAN 1 Kotanopan which impacted the low learning outcomes by students. Then, the other stage is a concept analysis that aims to explore the types of Batak culture according to community behavior that relate with the concept and theory of physics. The problems raised from Batak cultural elements in developing learning materials with cooperative learning models based on Batak culture include mangupa its traditional ceremonial tradition of mandailing tribe, traditional game marcungkil and traditional instruments gordang sambilan and sarune.

The results of the analysis was obtained refer to the concept analysis from Archimedes Principles, Momentum and Impulses, and Sound refers to the Core Competency (KI) and Basic Competency (KD) which can be seen in Table 1.

| Table 1. Analysis of Archimedes Principles, Momentum and Impulses, and Sounds |
| Sub Topics | Activity Type |
|------------|---------------|
| Archimedes Law | 1. Identify factors that influence buoyancy style in Batak culture. 2. Analyze the buoyancy force of an object in a liquid substance. 3. Explains the condition of floating and sinking objects. |
| Momentum and Impulse | 1. Identify the momentum, impulse, the relationship between impulse and momentum as well as the principles of momentum eternity in various problems solving in Batak culture. 2. Discussing about momentum, impulse, the relationship between impulse and momentum as well as the law of momentum eternity in various problems solving in Batak culture. |
| Sound | 1. Analyze the frequency that produce on each drum blows in different drum membrane diameters 2. Identify the concept of fast sound propagation. 3. Conduct experiments to investigate the frequency that produce on each drum blows in different drum membrane diameters |
| Sound Source | 1. Analyzing phenomena that occur in strings and organa pipes as a source of sound in Batak culture 2. Carry out experiments to investigate the phenomenon of strings and organa pipes. |
3.2 Stage Design

The purpose of the design stage is to design teaching text-book to obtain draft (e.g. teaching text-book) for Archimedes Principles, momentum and impulse, and sound based on learning by using a cooperative model based on Batak culture. The activities on this stage are media selection, format selection and initial design learning device. Media selection is in accordance with the analysis of concepts and tasks. Format selection is in accordance with curriculum 2013.

The first stage is produced the design of student’ books and teacher books for four meetings, student results tests, scoring guidelines, answer key, and student activity observation sheets. All the results of the design stage are called draft I.

![Figure 1 Student Book Cover View](image1.png)

![Figure 2 KD, Learning Objectives, and Keywords](image2.png)
3.3 Stage Develop

The first stage of the development is to validate draft I to experts and then conduct field trials. Validation of experts is focused on the format, content, illustration, and language of the learning materials developed. Validation is carried out by submitting teaching text-book components to the validator and their validation sheet to be further examined and assessed eligibility by the validator.

Physics teaching text-books was obtained the following average validity scores: (1) student books; a) 4.15 content aspect with valid category; b) Aspect of eligibility for presentation of 4.07 with valid category, (2) teacher's book; a) 4.18 content aspect with valid category; b) Aspect of eligibility of presenting 4.37 with valid category, and (3) learning results test instrument of 3.45 with good category. It shows teaching materials developed student books, teacher books and learning outcome instruments declared valid with good validity criteria.

Expert validation shows that draft I fulfilled the validity criteria with the category "valid with little correction, criticism, and suggestions used as the basis for revising and refining developed teaching text-book. The revised is a learning material that fulfilled valid criteria and is then called draft II.

Teaching text-books developed is practically reviewed from observations showing that at least 80% of many of the subjects studied gave a positive response and the other effectively reviewed from assessments conducted where there was an improvement in students' learning outcomes after the Batak culture-based physics teaching text-books were developed.

Teaching text-books developed and declared valid by validators are tested into the field. This trial was conducted twice, namely trial I and trial II. Based on the results of trial I, it was obtained that Batak culture-based teaching text-books developed already fulfilled all the practical criteria set. It can be reviewed from the student responses of more than 80% of students who give a positive response for teaching text-books. The average increase in student learning outcomes in trial I was 0.36 in the moderate category with classical student learning completed by 60%. It can be concluded that the results of the study in trial have not fulfilled the effective criteria on classical achievement.

After conducting the first test on draft II, further improvements were made to produce physics teaching text-books components that fulfilled all the practical criteria set. The revision results in draft II resulted in draft III it tested in Trial II. Based on the results of the second trial it can be concluded that the physics teaching materials developed based on Batak culture have met the practical criteria. The average increase in student learning outcomes in trial II was 0.48 in the moderate category with classical completeness of 88%. So it can be concluded that the test scores of student learning outcomes in the second trial have met the criteria for being effective in classical completeness achievement.

Referring to the indicator of the research reach in the effectiveness aspect there is an increase in students' learning outcomes and classical learning completeless. The results of Small group trial and
limited class trials. Batak culture-based physics teaching text-books developed have fulfilled the category effectively reviewed from the improvement of learning and learning completed students classically.

This improvement of student learning outcomes is due to the materials and problems contained in the student books developed in accordance with the conditions of the student's learning environment and refers to Batak culture-based learning. Through Batak culture that was raised as a contextual example, become spirit for the students to understand the culture. Students easier to understand the physics materials associated with Batak culture, because they will feel have that culture. Students are also taught scientific methods to develop critical thinking for dealing with problems [18]. The understanding will be constructed that by studying culture, students also get the knowledge about physics, how it relates to physics, how culture can blend with physics. The cultural background of students influences with learning process of students in their efforts to master the concepts of science taught in schools [19]. Through local wisdom-oriented learning can improve students' learning outcomes [20]. Local wisdom-oriented learning will give a more contextual and meaningful impression in the learning process so that students can easily understand the material learned.

3.4 Stage Disseminate
The dissemination stage was the last stage in the 4-D development model. At this stage, physics teaching materials that have been tested in the research class will be retested by comparing the physics teaching materials developed (experimental class) with the teaching materials commonly used by physics subject teachers at SMAN 1 Kotanopan (control class). However, this stage was not carried out by researchers, due to time, cost and energy limitations so this stage was not discussed in depth.

4. Conclusion
Based on the results of analysis and discussion in this study, it was obtained that physics teaching text-books based on Batak culture have met valid, practical and effective criteria to improve students' learning outcomes.

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