

## **The Development of Chemical Learning Materials Based On Projects with a Saintific Approach**

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**Abstract :** *This Study Aims To Develop A Chemical Learning Materials Based On Project With A Scientific Approach On The Material Rate Of Reaction As One Source Of Chemistry Study Of Senior High School Students And Determine The Quality Of Learning Materials Produced Based On The Assessment Of 3 Experts Consisting Of 3 Lecturers As Validator From Three Components Feasibility, Are Content, Structure And Language. This Research Uses A Modified 4D Development Model. Validation Results Indicate That The Resulting Learning Materials Is Valid And Feasible For Use In Senior High School Students.*

**Keywords:** *Development, Learning Reaction Rate Materials, Learning Resources*

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### **I. INTRODUCTION**

Use The PISA (Program For International Student Assessment) Defines Science Literacy As The Ability To Use Science Knowledge, Identify Questions, And Draw Conclusions Based On Evidence, In Order To Understand And Make Decisions Regarding Nature And Changes Made To Nature Through Human Activities [1]. Based On OECD (Organizational For Economic Coperation And Development) Report Through PISA 2010, Indonesian Students' Ability In Science, Reading And Math Literacy Is Ranked 57<sup>th</sup> Out Of 65 Countries. Indonesia Is In The Sequence Below Compared To Other Asian Countries [2]. As For 2012, Indonesia Ranks 64<sup>th</sup> Out Of 65 Countries [1]. Weak Ability Of Science Literacy Learners One Of Them Caused By Lack Of Adequate Teaching Materials In Order To Develop Literacy Science Learners.

Teaching Materials As One Learning Tool And Learning Resources For Learners Should Have An Important Role In The Learning Process To Assist Teachers In Directing Learning To Run More Optimally. Contrary To [3], Some Textbooks Referring To The Old Curriculum Stuffed Learners With Concepts That Must Be Memorized, And Did Not Invite Learners To Think As A Process Of Constructing Their Knowledge And Experience To Find Their Own Concepts To Understand And Discover Meaning And Relevance To Their Lives Individually, Society And State.

Teaching Materials Used By Teachers In The Learning Process In General In The Form Of Book Packages And Work Sheets Students In The Form Of Questions. Meanwhile, Supporting Materials To Facilitate Learning Process Activities That Enable Student To Be Able To Learn Independently Is Still Limited Existence. The Next Teaching Material Barrier Relates To Limited Available School Tools And Equipments. The Limited Computers Facility And The Limited Teachers Creativity In Determining Material Source Become Serious Barrier. Teachers Do Not Want To Find Text In Newspaper, Internet, Or Making Their Own Teaching Material Creatively. Teachers Choose Practically Using Available Book [4] As In SMAN 1 Lembar And SMAN 2 Lembar, Learners Do Not Have A Special Handbook Or Work Sheets Students As A Learning Supporter. Meanwhile, The Package Books Available In School Libraries Are Limited. Students Usually Borrow Books When There Are Tasks Assigned By The Teacher. Moreover, Teachers Record The Subject Matter On The Board To Be Copied By The Students. This Situation Of Course Will Not Be Able To Optimize The Learning Process In The Classroom. Thus, It Is Necessary Creativity Educators In Developing And Optimizing The Effectiveness Of The Learning Process, One Of Them By Doing The Development Of Learning Tools In The Form Of Teaching Materials That Can Be Used By Teachers As A Medium Of Learning. The Development Of Teaching Materials Is Expected To Be Used By Learners As An Alternative Teaching Materials To Improve The Existing Teaching Materials To A Better Direction And To Facilitate Learners In Improving The Ability Of Science Literacy And Learning Outcomes Of Learners.

Project-Based Learning (PBL) Can Be A Student-Centered, Interdisciplinary, And Long-Term Approach, Strategy Or Method Of Learning. As A PBL Teaching And Learning Strategy Involves Students To Work On A Project That Is Useful For Solving Community Or Environmental Problems. Characteristics Of Project-Based Learning Is A Focus On Important Concepts, Inquiry Processes, Student-Centered Learning,

Realistic Projects, Product Yields, Related To Authentic Real Issues And Constructive Investigation. While The Stages In Project-Based Learning, Among Others.

The Scientific Approach Is Closely Related To The Scientific Method. Scientific Methods Generally Involve Observation Or Observation Activities Required For The Formulation Of Hypotheses Or Collecting Data. Scientific Method Is Generally Based On The Exposure Of Data Obtained Through Observation Or Experiment. Therefore, Experimental Activities May Be Replaced By The

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Activity Of Obtaining Information From Various Sources [5].

According To The Education And Cultural Minister's Rule Number 81 A Of 2013, Annex IV [6] The Learning Process Consists Of Five Main Learning Experiences: Observing, Questioning, Gathering Information, Associating, And Communicating.

Based On The Above Description, The Researcher Aims To Develop A Chemical Learning Materials Based On Project With A Scientific Approach And To Determine Its Effectiveness Of Science Literacy And Learning Outcomes In Senior High School Students.

## **II. RESEARCH METHODS**

This Research Is A Development Study Intended To Produce The Product. The Research Procedure Or Design Used In This Research Is To Adapt The Development Of 4-D Model Device (Four D Model) By Thiagarajan, Semmel And Semmel With Modification As Per Research Requirement [7]. The Research Stage Of The 4-D Model Is Define, Design, Development And Disseminate Stages. Because The Results Of This Study Are Not Disseminated To Other Schools (Other Than The Researcher's Place) Then Only Used Three Stages, Namely Until The Stage Of Develop. Defining In This Case Is To Define And Define The Needs In The Learning Process. There Are Five Main Steps In This Stage: Pre-Research, Learner Analysis, Concept Analysis, Task Analysis And The Formulation Of Learning Objectives. Design, At This Stage Do Prototype Of Learning Materials. This Design Stage Consists Of A) The Format Selection B) The Initial Design Of The Learning Device. The Third Stage Is Development. This Development Aims To Produce Work Sheet Student In Chemistry And Other Learning Materials That Have Been Revised Based On The Input Of Experts To Be Tested To Learners.

## **III. RESULT AND DISCUSSION**

The Results Obtained From This Research Is The Result Of Development Of Project-Based Chemical Learning Tools With Scientific Approach. The Chemistry Learning Tools Developed In This Research Are In The Form Of Syllabus, Lesson Plan, Student Work Sheet, Test Of Learning Result And Science Literacy To Adapt The Development Theory Of 4D That Has Been Modified. This Stage Consists Of Defining, Designing And Development Stages.

### **1. Define**

Defining In This Case Is To Define And Define The Needs In The Learning Process. The Early Stages Of Learning Device Development Are Done By Defining And Defining Needs In The Learning Process. The Objective At This Stage Is To Obtain Information About The Conditions And Facts Of Chemistry Learning In The Field. Minimum Information Should Be Obtained From This Pre-Research Stage, Among Others, Problems That Arise In The Learning Of Chemistry. The Problems That Arise In The Learning Of Chemistry That Can Be Defined Include: (1) The Involvement Of Learners In The Learning Activities Is Still Low So That Students Tend To Be Passive, (2) The Development Of Thinking Skills Of Learners Related To The Material Discussed (3) Teaching Materials Used In The Form Of A Package Book That Is More Emphasized On The Material And The Questions So As Not To Show The Activities Of Learners In The Process Of Developing Thinking Skills And The Circumstances Are Still Limited In The School Library (4) Unavailability Student Work Sheet As Media And Learning Aids For Learners During The Learning Process (5) The Learning Method Used Is Still Dominated By Conventional Method. Based On These Problems Serve As A Basis In Determining The Learning Tools Needed For The Proper Application And Efficient.

Student Analysis Is Very Important At The Beginning Of Planning. This Analysis Is Done By Considering The Characteristics, Abilities, And Experiences Of Learners, Both As A Group And Individuals. Analysis Of Learners Is A Study Of The Characteristics Of Learners Include The Ability, Background Knowledge And Cognitive Development Level Of Learners. Subjects Used In This Study Were Class XI Students With Age Range 16-17 Years. According To Piaget's Theory [8] Learners Of That Age Category Are In A Formal Operating Stage Where Abstract And Pure Symbolic Thinking Is Done So That Problems Can Be Solved Through The Use Of Systematic Experimentation.

Task Analysis Is A Set Of Procedures For Determining The Contents Of A Unit Of Study. The Task

Analysis Is Done By Detailing The Task Of The Content Of The Teaching Eye In The Form Of An Outline. This Analysis Includes Content Structure Analysis, Concept Analysis.

**a. Content Structure Analysis**

The Subject Matter That Will Be Given To The Learner Is The Rate Of The Reaction. In General, The Subject Matter Of Reaction Rate Is As Follows: Understanding And Measuring Reaction Rate, Collision Theory, Factors Influencing Reaction Rate, Reaction Order And Reaction Rate Equation.

**b. Concept Analysis**

In This Analysis Is Done By Identifying The Main Concepts That Will Be Taught, Arrange Systematically And Detail The Relevant Concepts. The Results Of This Analysis Are Concept Maps.

**c. Analysis Of Learning Objectives**

The Formulation Of Learning Objectives Is Based On Conceptual Analysis And Task Analysis, So That It Can Become More Operational And Expressed By Observable Behavior. The Results Of Task Analysis And Concept Analysis Are Used As A Reference For Formulating Indicators Of Achievement Of Learning Outcomes And Learning Objectives, As The Elaboration Of Basic Competencies. The Formulation Of Learning Objectives Is The Basis For Designing Learning Tools And The Preparation Of Tests. The Formulation Of Learning Objectives For Basic Competence On Reaction Rate Material Is Through Learning Activities With Scientific Approach Using The Project Assignment Method Students Can Understand The Collision Theory In Chemical Reaction Based On The Influence Of Temperature On The Average Rate Of Particle Matter And The Influence Of Concentration On The Frequency Of The Collision; Determining The Reaction Order And Reaction Rate Constant Based On Experimental Data; Presents Ways Of Arranging Material Storage To Prevent Uncontrollable Changes And Can

Design, Malakukan, Summarize And Present Experimental Results Of Factors Affecting Reaction Rates And Reaction Order So That Learners Can Build Awareness Of The Greatness Of God YME, Cultivate Discipline Behavior, Honest, Active, Responsive, Courteous, Responsible And Cooperative.

**2. Stage Design**

At This Stage Do Prototype Design Of Learning Device. This Design Stage Consists Of:

A. Format Selection (The Selection Of The Format Is Adapted To The Students Work Sheet, Lesson Plan Learning Criteria Format And The Desired Learning Result Test. The Format Of Student Work Sheet Teaching Material Criteria Is Adapted From The Book Criteria Format Issued By BSNP).

B. Initial Design Learning Materilas

The Initial Design Of Students Work Sheet (In The Initial Drafting Of Students Work Sheet Draft Will Be Produced Students Work Sheet I With At Least Include In It, Namely:

- 1) Students Work Sheet Title That Describes The Material To Be Poured Into Students Work Sheet
- 2) Basic Competence And Indicators Of Achievement Of Competence To Be Achieved Learners After Studying A Material Using Students Work Sheet
- 3) Procedures Or Activities To Be Followed By Learners To Learn The Material Using Students Work Sheet In The Event There Is A Scientific Or Project Task To Support The Scientific Performance Of Learners.
- 4) Problems, Exercises And Or Tasks That Must Be Done Or Completed By The Learners

**2. The Initial Design Of Lesson Plan**

The Learning Implementation Plan, Which Is The Step-By-Step Guide That Will Be Done By The Teacher In The Learning Activities Arranged In The Scenario Of Activity [8]. Lesson Plans Can Be Arranged For One Or More Meetings. RPP Is Developed From The Syllabus To Direct The Learning Activities Of Learners In An Effort To Achieve Basic Competence . The Key Components In The Lesson Plan That Will Be Developed Will At Least Include:

- a. The Identity Of The School Is The Name Of The Educational Unit;
- b. Subject Identity Or Theme / Subtheme;
- c. Class / Semester;
- d. Subject Matter;
- e. Time Allocation Is Determined According To The Need For Basic Competences Achievement And Learning Load By Taking Into Account The Number Of Hours Of Lessons Available In The Syllabus And The Basic Competences To Be Achieved;
- f. The Learning Objectives Formulated Based On Basic Competences, Using Operational Verbs That Can Be Observed And Measured, Including Attitudes, Knowledge, And Skills;
- g. Basic Competencies And Indicators Of Achievement Of Competencies;

- h. Learning Materials, Containing Relevant Facts, Concepts, Principles, And Procedures, And Written In The Form Of Items In Accordance With The Formulation Of Indicators Of Competence Achievement;
- i. Learning Methods, Used By Educators To Realize The Learning Atmosphere And Learning Process So That Learners Achieve Basic Competences Tailored To The Characteristics Of Learners And Basic Competences To Be Achieved.
- j. Learning Media, In The Form Of Learning Process Aids To Deliver The Subject Matter;
- k. Learning Resources May Be Books, Printed And Electronic Media, The Surrounding Nature, Or Other Relevant Learning
- l. Resources;The Learning Steps Are Done Through Preliminary, Core, And Closing Steps; And
- m. Assessment Of Learning Outcomes.

### 3. Test Results Learning

Learning Result Test Is Made Referring To The Basic Competence To Be Achieved, Elaborated Into Indicators Of Achievement Of Learning Outcomes And Prepared Based On The Grid Of Writing The Complete Item With The Key Answer Used To Measure The Ability Of Learners [5]. The Test Of Learning Outcomes To Be Developed Includes The Test Of Cognitive Learning Outcomes For The Material Of The Reaction Rate Based On The Indicators Of Achievement Of The Competence To Be Achieved And The Science Literacy Test Of Learners Based On The Science Literacy Indicator Includes Explaining Scientific Phenomena, Evaluating And Designing Scientific Research And Interpreting Scientific Data And Evidence.

### 4. Development Stage

This Development Stage Aims To Produce Student Work Sheet Chemistry And Other Learning Tools That Have Been Revised Based On Expert Input. Validation Of The Device Followed By Revisions This Stage Aims To Get A Suggestion That Is To Know The Truth Of The Contents And Format Of The Draft Of The Learning Device Chemistry That Has Been Produced At The Design Stage. Validity In A Development Study Includes Content Validity And Construct Validity. Product Development Is Said To Be Valid If The Product Is Based On Adequate Theory (Content Validity) And All Components Of The Product To Each Other Related Consistently (Construct Validity). Content Validation Indicates That The Product Developed Is Based On The Curriculum Or Based On Strong Theoretical Rationale. Whereas Construct Validation Shows Internal Consistency Between Product Components. In This Case, The Validation Process Involves Three Expert Validators. The Purpose Of This Validation Is To Know The Truth Of The Content And Format Of Syllabus Student Work Sheet, Lesson Plan And Test Of Chemistry Learning Result Developed By The Researcher. After The Student Work Sheet<sup>st</sup>

Draft Has Been Validated And Revised, The Draft Student Work Sheet<sup>nd</sup> Is Produced. Once The Device Has Been Developed, The Next Step Is Expert Validation. Expert Validation Is Performed By 3 Validators. Validation Results Are Presented In Table 1.

**TABLE 1.** Result Of Validation

Developed Learning Materials	Average Value			Avarage	Information
	Validator 1	Validator 2	Validator 3		
Syllabus	3.4	3.75	3.25	3.47	Valid
Lesson Plan	3.08	3.5	3.17	3.25	Valid
Student's Work Sheet	3.1	3.6	3.21	3.3	Valid
Test Results Learning	3	3.63	3.25	3.29	Valid
Science Literacy Tes	3	3.44	3.33	3.27	Valid

Based On The Above Table, Indicating That The Project-Based Chemical Learning Tool With A Scientific Approach Is Valid And Worthy To Use. This Research Is In Line With Ardan [9] That Development Learning Materials Has Developed Value Added As A Learning Tool Students And Additional Information Make Teachers And Students.

### IV. CONCLUSION

Based On The Purpose Can Be Conclude That Chemical Learning Materials Basen On Project With Scientific Approach Has Been Developed Was Valid And Worthy To Use.

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