CHAPTER III
RESEARCH METHODOLOGY

3.1 Overview of Research

This research includes development research using a modified Borg and Gall (1989) resource development model. Motede research used is research and development method (R & D). The research and development methods themselves are used to produce specific products, and test the effectiveness of particular products. The teaching materials developed in this study is a article chemistry Based on Science Literation with *Salt Hydrolysis* material.

3.2 Place and Time Research

This research was conducted in SMA N 1 Tebing Tinggi. The research time conduct on February up to March 2018, even semester of XI class academic year 2017/2018.

3.3 Research Population and Sample

The Population of this research was all student Senior High School in grade XI science in SMA N 1 Tebing Tinggi. The sample is randomly chosen sampling due to the limitation of researcher. The research choose the sample were two classes in SMA N 1 Tebing Tinggi. The sample this research was taken by random sampling. The first class as experimental class I and the second class as control class II. Each class consist of 36 students.

Determination of sample in this research is using "Purposive Random Sampling", from each units of class was taken two classes as a research target, consisting of one as experiment class that using the article media based on science literation and the another as control class that using direct interaction conventionally.

3.4 Research Variables & Instrument.

There are two different variables in this research , they are :

1. Independent variable, those are variation in the teaching by Module Based on Literation Science.
2. Dependent Variable, is student's Achievement in teaching of Salt Hydrolysis topic.

The instrument used in this research are evaluation test (Pretest, Post test). Data collection tool used in this research are multiple-choice tests that account for 30 questions with five options and given twice the pretest and post test. The evaluation test are arranged based of the topics being taught in the research. Before using the evaluation test, the item on the evaluation test has been validated by standard procedure. The question of evaluations are assed to investigate the normality, homogeneity, validity, reliability, and level of difficulties of the instrument.

3.5 Reasearch Design

Figure 3.1 can explain the steps of research conducted by researchers. Broadly speaking, the research mechanism is divided into five stages in accordance with the needs of development of science-based teaching materials. *The first stage* is preparation, the researcher determines the chemistry textbook to be analyzed then the researcher analyzes the book. *The second stage* is development, the researcher develops the subject of chemistry in class xi based on science literacy. *The third stage* is validation, the subject matter will be standardized by using BSNP standard questionnaire and the science literacy standard questionnaire with the help of validator experts given to the chemistry lecturer in order to get the responses and assessment of the developed teaching materials. *The fourth stage* is the revision, the teaching materials that have been developed based on the ratings, suggestions, and comments given by the lecturer. *The fifth stage* is the implementation, Figure 3.2 can explain the implementation steps that will be done by the researcher.

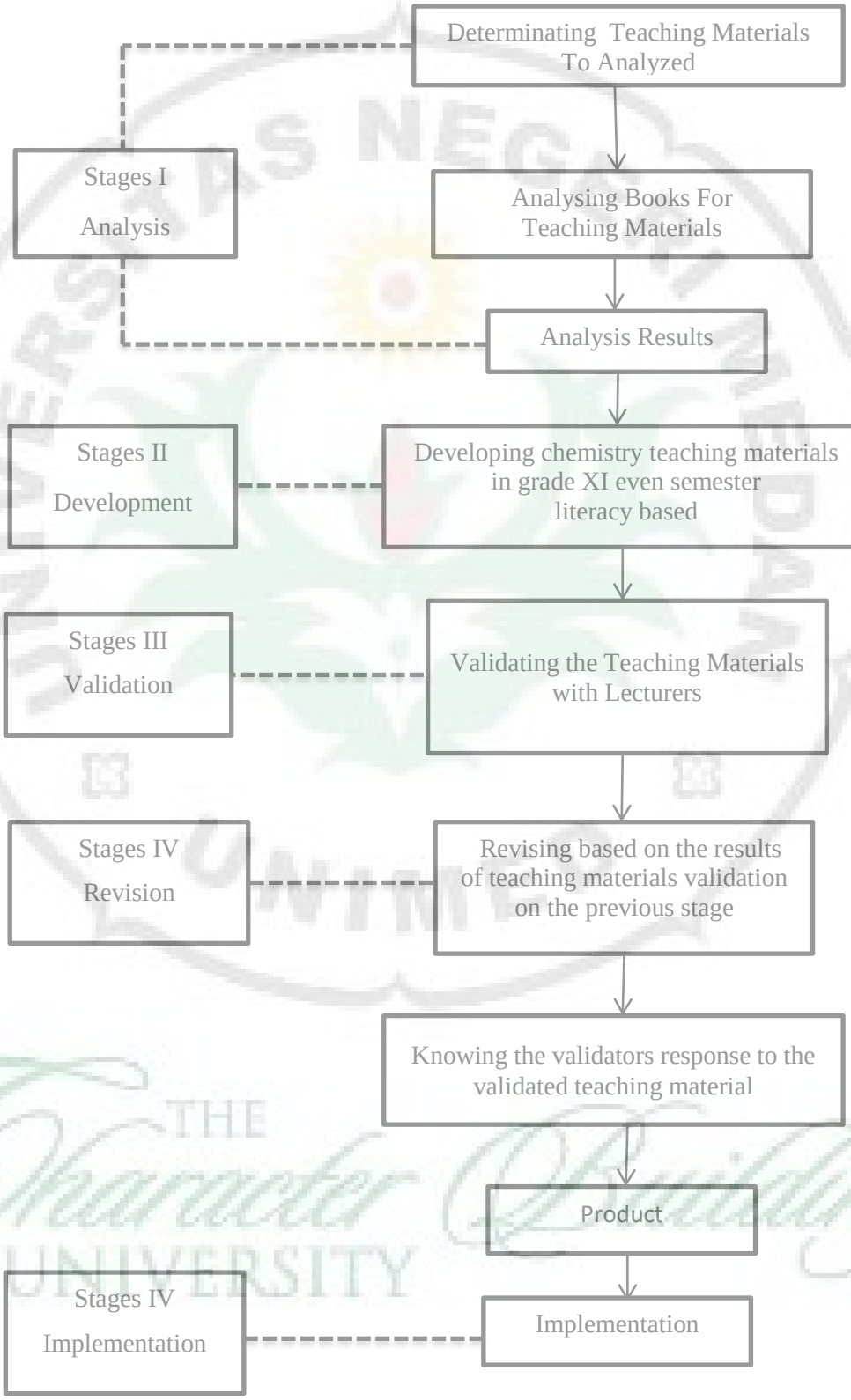

Figure 3.1 Flow Chart of The Development Teaching Material Based on Scince Literation.

This research involved two classes, those are experimental class , control class and treated differently. In the experiment class is treated with the teaching using Module Based on Science Literation. While the control class is treated the teaching using Module in the School. To determine student's learning outcomes obtained by applying this treatment then the student is given a test. The tests are given a pretest and post test . Research design is described as follows:

Table 3.1 Research Design (Group two, Pretest and Posttest)

Group	**Pretest**	**Treatment**	**Post test**
Experiment Class	Y_1	P_1	Y_2
Control Class	Y_1	P_2	Y_2

Y_1 : pretest

Y_2 : post test

P_1 : Learning with using Module Based on Science Literation.

P_2 : Learning with using Module in the School.

In accordance with the objectives of research and to conducted the data so this research are Quasi experiment. To get homogeneous classes should be conducted the following steps:

1. Both classes were given pretest
2. Both classes were given the same material
3. Time Allocation to give material is same
4. Teachers who teach the material is same (teacher is researcher her self)
5. The difference only lies in the treatment of learning by using Module Based on Science Literation on Salt hydrolysis topic and teaching using using Module in the School on Salt hydrolysis topic.

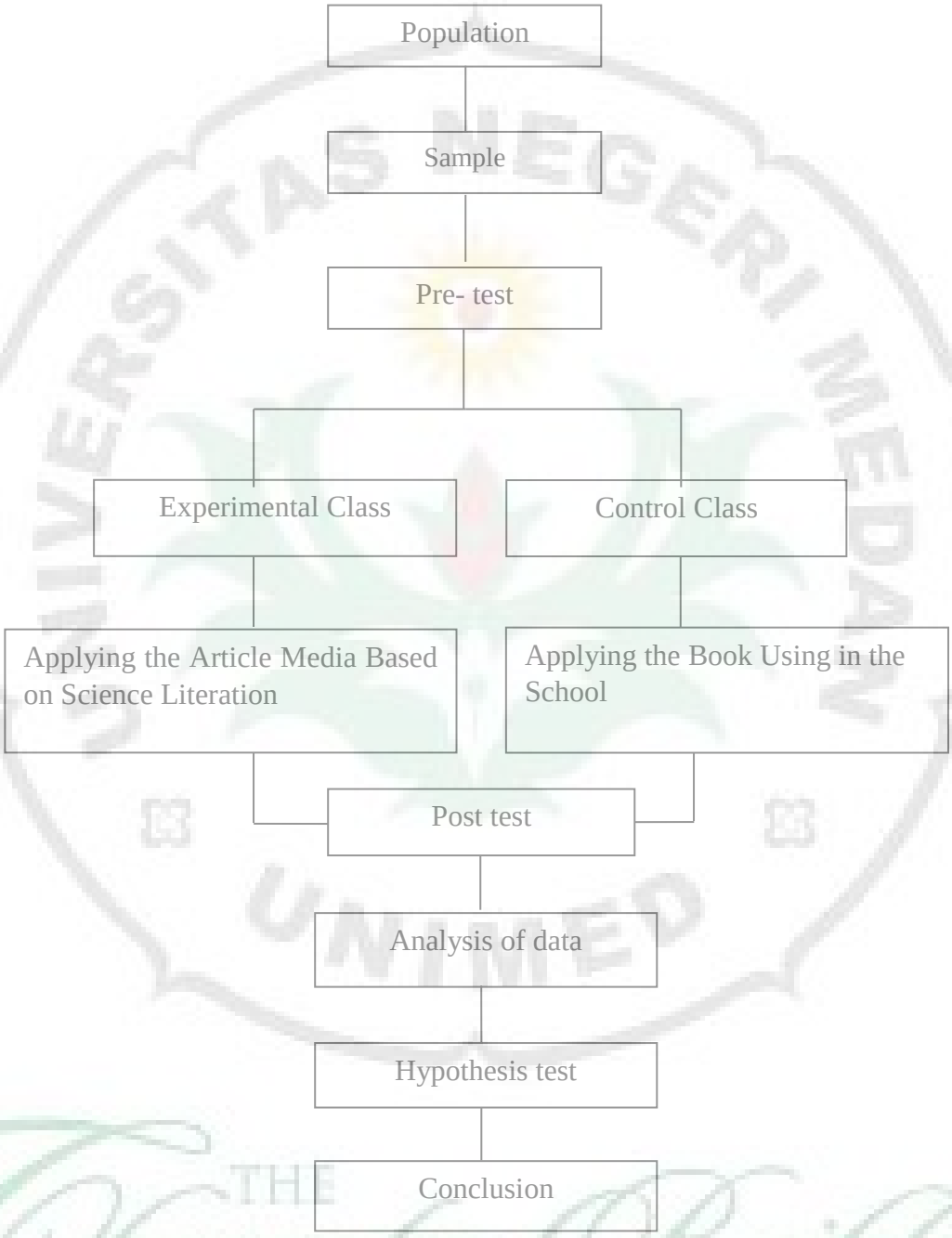

Figure 3.2 Flow Chart of The Research Implementation of Teaching Material Based on Science Literartion

3.6 Research Procedure

The procedure in this study is to follow the research procedures that have been done by previous researchers consisting of several stages, including:

3.6.1 Preparation Stage

At this stage, the researcher determines chemical textbooks from 3 different authors to analyze, identify and collect information about the textbook.

3.6.2 Development Stage

At this stage, the researcher determines the design and design of the initial product of a based on science literation of science article by collecting sources derived from relevant books, journals, images of supporting materials via the internet.

3.6.3 Validation Stage

At this stage, chemistry articles developed are then validated by expert respondents. Respondents were asked to assess based on standard assessment of teaching materials set by BSNP and science-based literacy based standards. This stage aims to determine the feasibility of products developed in science-based science literacy materials for class XI IPA even semester high school.

3.6.4 Revision Stage

At this stage, researchers revised the materials of chemistry-based materials science literacy class XI semester even that has been developed based on the results of standardization assessment conducted. Revisions are made to correct the weakness of the instructional materials developed based on the ratings, suggestions, and comments provided by the validator expert.

3.6.5 Implimentation Stage

At this stage, valid products will be implemented in the learning process and see how much influence they have in learning. This final product trial is

conducted to know the effectiveness of science-based literacy materials to students of class XI IPA. The research used to test the effectiveness of teaching materials is a pretest-posttest control group design design using true experimental design method. Before the trial run, the group of students to be used is the control class and the experimental class is selected using random sampling. The control class uses conventional books and experimental classes using science-based literacy materials.

3.7 Types of Data Research

The data obtained in the development and effectiveness of teaching materials based on science literacy is in the form of quantitative data collected through questionnaires with a rating of 1 to 4 and students cognitive results both pretest and posttest students obtained from giving 20 questions in the form of multiple choice after students learn to use article based science literacy using ordinary books. After that the type of data collected is qualitative data in the form of a description of advice and written input from the validator.

3.8 Data Collection Teachniques

Data collection techniques in this study is to use research instruments to assess the product materials that have been developed. Instruments used for data collection on research development and effectiveness are as follows:

a. Form of teaching material suitability test

This questionnaire is used to obtain assessment data from validator experts about products developed of teaching material based on science literation on chemistry learning in class XI even semester.

b. Form of science literacy improvement

Improvement test of scientific literacy load is done two stages namely pretest and posttest. Both control and experiment classes are given pretest and posttest. Pretest is a test given before the treatment for the experimental class whereas for the control class is given before ordinary learning begins. Posttest is

given after treatment for the experimental class whereas for the control class is given after ordinary learning begins.

3.9 Technique of analysis

3.9.1 Data Analysis

Technique analysis of data in this research is quantitative data analysis and will be analyzed using descriptive analysis percentage. Percentage descriptive analysis is used to describe each percentage. According to Rohmad, et al (2013: 2) in the descriptive analysis of this calculation percentage is used to determine the percentage score of answers from each sample used the formula:

$$P\% = \frac{\sum q}{\sum r} \text{ X } 100\%$$

Where:

P% = percentage score obtained, in this case the percentage component of the standard assessment of textbook content according to BSNP

Σq = Number of concepts with marks (√) on teaching materials (modules) chemistry

Σr = Number of concepts that exist in chemistry teaching material (module).

The data will be tabulated in a recapitulation table, with the following categories: <0.40: very bad; 0.40 - 0.75: Good; > 0.75: very good. In this study, the rating scale used is 1 to 4, where the lowest score is 1 and the highest score is 4. The determination of the range can be known through the highest score range minus the lowest score range divided by the highest score. Based on the determination of the range obtained a range of 0.75. The score assessment will be explained as follows:

a. Number 4 means very good / very valid / very interesting / very easy / very clear / very precise / strongly agree.
b. Number 3 means good / valid / interesting / easy / clear / precise / agree.

c. Number 2 means less good / less valid / less interesting / less easy / less clear / less appropriate / less agree.
d. Number 1 means bad / very invalid / very unattractive / very uneasy / very unclear / very inappropriate / strongly disagree.

Tabel 3.2 Advisability Criterion scale of learning module based on Respondents

Average	Validation criterion
3,26-4,00	Valid and no revision needed
2,51-3,25	Quite valid and no revision needed
1,76-2,50	Less valid, some book contents need revision
1.00-1,75	Invalid and needs total revisions

(Arikunto, 2002)

3.9.2 Instrument Analysis

3.9.2.1 Validity Test

The calculated that used in validation of instrument test is SPSS 22 for windows, to see the output of correlation score between item score with total score. Next, comprehend with r_{table} ($\alpha = 0,05$). If $r_{calculated} > r_{table}$, the item can called valid, but if $r_{calculated} < r_{table}$ the item is invalid and must correctly .

And then, The validity of test which is used in this research is empiric validity, whereas technique which is used is product moment. According to Silitonga (2011) research instrument said to be valid, when able to measure what is being measured. Type test that used in this research is multiple choice , the formula of test validity that used in multiple choice forms can be seen in equation:

$$R_{xy} = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{(N\sum X^2 - (\sum X)^2\ (N\sum Y^2 - (\sum Y)^2)}}$$

Note; R_{xy} : the coefficient correlation between the variables x and y, the two variables are correlated

X : score item

Y : total score

N : total of students

Criteria to interpret the value of validity of question, then that value were consulted to value chart from r product moment with α 5% with the criterion, if the calculation was measured are $R_{xy} > Tt_{able}$, then the question was valid (Silitonga , 2011).

3.8.2.2 The reliability

The test reliability is show in a understanding that a instrument enough can be trusted to used as data collecting tool because the instrument is already good. The reliability of the test is consistency of measurement. In SPSS 22 for windows program with using Cronbach's Alpha method . If Reliability score less from 0.6 is bad categorized, if 0.7 accepted and than if upper 0.8 is good categorized.

And then, To obtain the reliability of the test, this research using Kuder Richardson's formula, that's K-R 20 because the test is multiple choices. The formula that using to determine the reliability of test is :

$$R_{11} = \left(\frac{k}{k-1}\right) \frac{S^2 - \sum P_q}{S^2}$$

Note: R11 : reliability

P : object proportion who answered the item correctly

ΣP_q : the amount of multiplying p and qn

k : the number of questions

S : standard deviation of the test (the standard deviation is the root of the variance), which can be searched by the equation:

$$S = \frac{\sum Y2 - \frac{(\sum Y)2}{N}}{N}$$

N : the number of participant

Σx^2 : the amount of deviation from the mean squared.

Criteria if $r_{count} > t_{table}$, so the instrument can be said to reliable.

3.8.2.3 The difficulty Level

The difficulty of the test is also evaluated by using discrimination index of the test to investigate the ability of the instrument to differ with student. Terms of

the difficulty, the question which good is question that have characteristics not very easy and not very difficult. The question is too easy not stimulate students to improve their relation effort. The question are too hard will cause student become desperate and not have the spirit to try again because outside range of abilities . (Arikunto,2010). In this research the test of difficulty level is done by using formula:

$$P = \frac{B}{Js}$$ (Silitonga, 2011).

Note: P : index of difficulty

B : the number of students who answered that question correctly

Js : the total number of students taking the test

From the calculate, criteria of difficulty level such as:

If P < 0.20 difficult question categorized .

If P (0.21-0.80) medium question categorized.

If P > 20 easy question categorized.

3.8.2.4 Different Index

Different index is capabilities of question, which can differentiate between highly achievements of students with the low achievement. The price that shows the size power differentiation is called the different index. In this research use multiple choices as instrument, which has function to measure the level of ownership of the concept of student. The formula of index that used formula:

$$D = \frac{B_A}{J_A} - \frac{B_B}{J_B} = P_A - P_B$$ (Silitonga, 2011).

Note: D : distinguishing power

J : Total participants

J_A : the number of upper participants

J_B : the number of under participants

B_A : the number of upper participants who answered the question correctly

B_B : the number of under participants who answered the question correctly

Test item fulfill criteria if D have the point between +0.20 until +1.0. Classification of discrimination index (D) such as:

D = 0.00 - 0.20 is bad categorize

D = 0.21- 0.40 is adequate categorize

D = 0.4 - 0.7 is good categorize.

D = 0.71 – 1.00 is very good categorize.

1.8.2.5 Normality Test

In the process of data test, the main steps that must be done is the data to be analyzed must be normally distributed. Furthermore, the use of one particular test, the data which is analyze must be homogeneous, in the regression analysis must be assuming linearity (Silitonga 2011). The calculated of Normality test can using One sample t-test *Kolmogorov-Smirnov* SPSS 22.

The procedure in determined of normality is:

a. Make the hypothesis

   Ho = sample data is normal distributed

   Ha = sample data is not normal distributed

b. Statistic test: *Kolmogorov-Smirnov* test

c. Alpha = 0,05

d. From calculated using SPSS, sign score is:

   Critic score: Ho Un accepted if Sign < Alpha

And then, by using parametric statistical should be done normality tests of data firstly and other test. To test the normality performed by Chi Square test (X^2). Testing normality of the data with Chi Square test (X^2) are as follows:

1. Determine the number of interval class in which for Chi Square test determined the number of intervals class = 6. This is in accordance with 6 fields that exist in standard normal curve.
2. Determine the length of interval class (PK) with the formula:

$$\text{Length of interval class (PK)} = \frac{Higher\ Data - Smaller\ Data}{6}$$

3. Arrange the data into a helper table to determine the price of Chi Square count.

4. Compare prices of Chi Square (X^2) count with Chi Square table at $\alpha = 0.05$ to db = 5. If the price of Chi Square (X^2) count < price of Chi Square table then the data is normally distributed.

3.8.2.6 Homogeneity Test

The largest and smallest variation values obtained by using SPSS 22 for windows. The criteria is : If $C_{alculated} < T_{table}$, so H_o is accepted (homogeneity) in significant $\alpha = 0,05$.

Homogeneity test by using manual, the formula is :

$$F = \frac{S_1^2}{S_2^2} \qquad \text{(Sudjana, 2011)}$$

Note: S_1^2 : The bigger variant of data

S_2^2 : The smaller variant of data

Criteria of Test:

H_o is rejected if $F_{count} < F_{table}$ in significant level $\alpha = 0.05$ so the data are homogeny.

3.8.2.7 Hypothesis Testing

In this research, Hypothesis that use is Independent Sample T-Test. The calculated of data by SPSS 22 for windows. The criteria is :

If $c_{alculated} > t_{able}$ so, Ho Unaccepted and if $c_{alculated} \leq t_{able}$ Ho accepted with (df) = $n_1 - n_2 - 2$ and significant $\alpha = 0,05$. Where $c_{alculated}$ can we calculate in output SPSS 22 for windows.

And then, The hypothesis data by using right side t-test (Sudjana, 2011) is calculated with formula :

$$t = \frac{\bar{g}_1 - \bar{g}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

The description:

$g_{eksperimen}$ = average of normalized gain at experiment class

$g_{kontrol}$ = average of normalized gain at control class

n_1 = total sample in experiment class

n_2 = total sample in control class

S_1 = variance of gain in experiment class

S_2 = variance of gain in control class

The value of t_{count} is compared to the value of t_{table} which in obtain from list if $t_{count} > t_{table}$ at level $\alpha = 0.05$ and degree of freedom (dk) = n1 + n2 – 2 is meaning receive Ha or refuses Ho.

3.8.2.8 Percentage of Improved Learning Outcomes

Percent of increase learning outcomes can be calculated by the formula g factor (gain score normalized). The formula of g factor used to determine the acquisition of student learning outcomes. Percentage of increase learning outcomes can be calculated directly from the average value of all the students for each class. (Meltzer, 2002)

G factor formula used is as follows:

$$\% \text{ g} = \frac{score\ post\ test - score\ pretest}{score\ maximum - score\ pretest}\ x\ 100\ \%$$

Value of increase (g) from each student then averaged and correlated with a range of:

$g < 0.3$ = learning outcome is low

$0.3 \leq g \leq 0.7$ = learning outcome is medium

$g > 0.7$ = learning outcome is high