CHAPTER III
METHODOLOGY

3.1. Research Method and Research Design

3.1.1 Research Method

The research method that is used in this research was quasi experiment. According to the best, Chreswell and Fraenkel (2012) stated that Quasi experiments include assignment, but not random assignment of participants to groups. Researchers who employ these designs rely instead on other techniques to control (or at least reduce) threats to internal validity. The quasi-experimental approach introduces considerably more threats to internal validity than the true experiment. Because the investigator does not randomly assign participants to groups, the potential threats of maturation, selection, mortality, and the interaction of selection with other threats are possibilities.

. This is because the experimenter cannot artificially create groups for the experiment (Creswell, 2102). This method is appropriate with the purpose of the research which is investigating The Effect of Stellarium as Interactive Multimedia on Students' Understanding and Motivation in Learning Solar System Topic.

3.1.2 Research Design

The design that used in this research was pre-test and post-test design (Creswell, 2012). The researcher assigns intact groups the experimental and control treatments, administers a pre-test to both groups, conducts experimental treatment activities with the experimental group only, and then administers a post-test to assess the differences between the two groups

Tabel 3.1. Pre-test and Post-test Design

Select Control Group	Pre-test	Learning without Stellarium	Post-test
Select Experimental	Pre-test	Learning with	Post-test

Group		Stellarium	

(Creswell, 2012)

3.2 Population and Sample

1. Research Location and Period

   The research was conducted at one of Junior Independent High school precisely in Padalarang, West Bandung which conducted at period of 2016/2017. The curriculum that is used in this school is 2013 of Curriculum or it called Kurtilas (National Curriculum). They were use bilingual as instructional language.

2. Population and Sample

   The population in this research was 8th grade students at Internationl Junior High School in Bandung which use 2013 of Curriculum who have not studied the solar system topic. There are three classes that provide for this research, thus the researcher was conduct sampling selection to determine which being experimental group and control group. The sampling technique that is used for this research was a convenience sampling**.** A convenience sample is a group of individuals who (conveniently) are available for study (Fraenkel , Wallen, & Hyun, 2011). The researcher selects participants because they are willing and available to be studied. The researcher decides to study this group at this one school because they are available and because the researcher has the permission of the principal (Cresswell, 2012)

   The consideration is because the researcher chooses sample based on the requirement such as the school implemented the curriculum 2013, and students who will learn about concept that will be tested due to limited and resources The samples are two classes in 8th grade, A class as experimental class and B class as control class.

3.3 Assumption

The assumptions as the foundation of this study as follow:

1. Many researchers agree that multimedia has many advantages in facilitating learning. It was found that interactive multimedia learning takes less time, is more enjoyable and increases learning (Jaafar & Yahaya, 2015). So it will be better if we use kind of media, such as interactive multimedia to increase student's motivation in learning.
2. Cognitive skills: such as being able to construct informal rules for solving problems; classify objects according to given criteria; form hypotheses; and reason logically. The review authors suggested that these skills were important for creating 'learner readiness'. (Meyyer, Haywood, Sachdev, & Farraday, 2008)
3. Student motivation naturally has to do with students' desire to participate in the learning process. But it also concerns the reasons or goals that underlie their involvement or noninvolvement in academic activities (Gregory, 2009).

3.4 Hypothesis

Hypothesis that is tested in this study is as follows:

Students' understanding

1. H_0: There is no different of students' understanding in learning solar system using *Stellarium* as an Interactive Multimedia and not using *stellarium*
2. H_1: There is difference of students' understanding in learning solar system using *Stellarium* as an Interactive Multimedia and no using *stellarium*

3.5 Operational Definition

1. Learning activities using *stellarium* as interactive multimedia is done by constructivist learning. Learning process is conducted by showing *stellarium* as interactive multimedia to students in teaching learning process. Stellarium that use in this research is stellarium computer based 0.15.1 version
2. Conceptual mastery in this research is the competence of students that covers the level cognitive such as remembering (C1), understanding (C2), applying (C3), Analyzing (C4) and evaluate (C5). This competence is measured by

objective test, which consist of the multiple choice questions (pre-test, before the treatment applied on students and post-test, after the treatment applied on students)

3. Students' Motivation is factor that's influence students achieve their achievement in learning. Data obtained through questionnaire that is adapted from COLDEX questioner and International Journal of Science Education which written by Hsiao-Lin Tuan, Chi-Chin Chin , Shyang Horng Shieh, (Taiwan) given for the students at the end of the treatment.
4. Solar System topic is referred to 2013 Curriculum.

3.6 Research Instrument

In this research, instrument is necessary to be used for gaining data. There are two types instrument that are used in this research. Those instruments are described below.

1. Objective Test is used as an evaluation to measure the concept mastery of the students in the pre-test and post-test. Objective test is in form of multiple choice questions based on Bloom's Revised

2. Questionnaire will be used to analyze students' motivation which adapted from International Journal and COLDEX

3.7 Data Collection Technique

There are two instruments used by researcher in conducting this research. The three instruments has different way to be measured. The data collection techniques are explained as follows:

3.7.1 Data of students' Cognitive Mastery

Students' understanding is the quantitative data of this research. The data has been collected through objective test in form of multiple choice questions of 20 questions. The result then be collected and analyzed by using the normalized gain.

Table 3.2 Test item Of Students' Understanding

Indicator	Test item
1) Remembering	1,2,13,16
2) Understanding	3,4,5,12,14
3) Apply	6,7,17,18
4) Analyze	8,9,11,15
5) Evaluate	10,19,20

The data was analyzed in term of its discriminating power, difficulty level and validity by using ANATES.

a. Validity

In order for research data to be of value and of use, they must be valid. Validity is an indication of how sound your research is. Validity indicates the extent of the question, task or grains in a test or instrument capable of representing all the content and proportional. The data valid if the test items reflect the entire content or material tested or should be proportionally (Matondang, 2006). The term *validity*, as used in research, refers to the appropriateness, meaningfulness, correctness, and usefulness of any inferences a researcher draws based on data obtained through the use of an instrument (Fraenkel et al ,2011). To determine the number of validity by ANATES its need the interpretation of validity this is tabulated in table 3.3

Table 3.3 Interpretation of Validity

Value of r	**Interpretation**
0.00-0.20	Very Low
0.20-0.40	Low
0.40-0.60	Enough
0.60-0.80	High
0.80-1.00	Very High

Source: Arikunto, 2010

b. Reliability

Reliability refers to the consistency of scores or answers from one administration of an instrument to another, and from one set of items to another (Fraenkel , Wallen, & Hyun, 2011). The interpretation of reliability is tabulated in table 3.4

Table 3.4 Interpretation of Reliability

Reliability Coefficient	Interpretation
0.00-0.20	Very Low
0.20-0.40	Low
0.40-0.60	Enough
0.60-0.80	High
0.80-1.00	Very High

Source: Arikunto, 2010

c. Difficulty Level

Item difficulty may be defined as the proportion of the examinees that marked the item correctly. Item difficulty is the percentage of students that correctly answered the item, also referred to as the p-value (Boopathiraj & Chellamani, 2013). The interpretation of difficulty level is tabulated in table 3.5

Table 3.5 Interpretation of Difficulty Level

Value of Difficulty Index	Interpretation
0.00-0.30	Difficult
0.30-0.70	Moderate
0.70-1.00	Easy

Source : Arikunto, 2010

d. Discriminating Power

Item discrimination or the discriminating power of a test item refers to the degree to which success or failure on an item indicates possession of the ability being measured. It determines the extent to which the given item discriminates among examinees in the function or ability measured by the

item (Boopathiraj & Chellamani, 2013). According to Cohen discriminating power describe a testee's proficiency in terms on his or her achievement of an item of a known difficulty level (Cohen, Manion, & Morrison, Research Methods in Education , 2007). The interpretation of Discriminating Power is tabulated table 3.6

Table 3.6 Interpretation of Discriminating Power

D=	Quality	Recommendations
> 0.39	Excellent	Retain
0.30-0.39	Good	Possibilities for Improvement
0.20-0.29	Mediocre	Need to check/review
0.00-0.19	Poor	Discard or revies in depth
< -0.01	Worst	Definitely discard

(Backhoff, Larrazolo, & Rosas, 2000)

e. Distractor

Distractors are the stuff of multiple choice items, where incorrect alternatives are offered, and students have to select the correct alternatives (Cohen, Manion, & Morrison, Research Methods in Education , 2007). The result then analyzed in term of its discriminating power, difficulty level, and validity by using ANATES. The recapitulation of test item is tabulated in 3.7

Table 3.7 Recapitulation of Test Item for Students 'understanding

Question Number	Discriminating Power	Difficulty Level	Validity	Status
1	Poor	Difficult	Validated	Used
2	Poor	Difficult	Low	Revise
3	Excellent	Difficult	Validated	Used
4	Excellent	Moderate	Validated	Used
5	Excellent	Moderate	Validated	Used
6	Poor	Difficult	Low	Revise
7	Excellent	Moderate	Validated	Used
8	Poor	Difficult	Validated	Used

9	Excellent	Moderate	Validated	Used
10	Excellent	Easy	Validated	Used
11	Excellent	Difficult	Validated	Used
12	Excellent	Difficult	Validated	Used
13	Poor	Moderate	Low	Revise
14	Excellent	Moderate	Validated	Used
15	Poor	Difficult	Low	Revise
16	Poor	Difficult	Validated	Used
17	Excellent	Moderate	Validated	Used
18	Poor	Difficult	Low	Revise
19	Excellent	Moderate	Validated	Used
20	Excellent	Moderate	Validated	Used

3.7.2 Instrument Non-Test Requirement

Questionnaire

Questionnaire was used to getting know the response of the students towards implementation of Stellarium as an interactive multimedia in learning solar system. The questionnaire was given to the students before and after implementation of stellarium in learning activity. The questionnaire consist of 30 questions divided into three topics, there are solar system topic, technology topic and stellarium. The questionnaire was used likert scale where the scale consist of several choice there are “strongly agree, agree, not sure, disagree, and strongly disagree”. The questionnaire statement is tabulated in table 3.8

Table 3.8 Questionnaire Statement

No	Aspect	Statement	
		Number Positive Statement	Number Negative Statement
1	Tata Surya Topic	1,3,5,6,7,8,9,10	2,4
2	Usage of	1,4,5,7,9,10	2,3,6,8

	Technology		
3	Stellarium	1,2,3,5,8	4,6,7,9,10

3.8 Processing Data

Data was obtained from both qualitative and quantitative data. Quantitative data was obtained from pre-test and post-test. These data is used to measure improvement of students' understanding. Qualitative data was obtained from motivational questioner that is used to gain the motivation of students from learning by stellarium as an interactive multimedia in learning process. Explanation of data processing techniques were obtained as follows:

3.8.1 Quantitative Data Analysis

Quantitative data analysis was done by Microsoft Excel calculation to determine the score of pre-test and post-test. The process of data calculation is explained as follows:

b. Scoring of Test Item

Pre-test and post-test test item was calculated to know the result of each student. The question of each test item pre-test and post-test is 20 questions.

c. Calculate the Gain and Normalized Gain.

After scoring the test item, the data was processed to know the gain score and normalized gain score. The improvement (gain) from pretest to posttest can be computed for each participant by subtracting each person's pretest score from his or her posttest score (Becker, 2000). Gain it can be assumed as the score of students' improvement after the treatment was given. Hake advocated using normalized gain because, for his data, this measure strongly differentiated between teaching methods, but allowed for "a consistent analysis over diverse student populations with widely varying initial knowledge states." That is, it appeared to be independent of population or pre-test scores, allowing instructors to compare their students' learning to those of other students at very different kinds of institutions. The normalized gain, introduced by Hake 1998 "as a rough

measure of the effectiveness of a course in promoting conceptual understanding," has become the standard measure for reporting scores on research-based concept inventories. Hake defined the average normalized gain as:

$$< g >= \frac{\%S_f - \%S_i}{100 - \%S_i}$$

Description:

<g> = Normalized gain

S_f = Post-test score

S_i = Pre-test score

Average of normalized gain (<g>) which is formulated as:

$$< g >= \frac{\% < G >}{\% < G > max} = \frac{(\% < S_f > - \% < S_i >)}{(100 - \% < S_i >)}$$

Description:

<g> = Normalized gain

<G> = Actual gain

<G> max = Maximum gain possible

<S_f> = Average of post-test score

<S_i> = Average of pre-test score

(Hake, 1998)

Table 3.9 Interpretation of N-gain

N-gain Score	Category
(<g>) > 0.7	High
0.7 > (<g>) > 0.3	Medium
(<g>) < 0.3	Low

d. Normality Test

Normality testing is a test about the normal distribution of data. This test is the most widely performed test for parametric statistical analysis. The data that is normally distributed is a requirement for parametric tests. As for

data that does not have a normal distribution, then the analysis using non parametric test (Hafizah, 2000). This research was measure by Sapihro Wilk normality test, because the group will be in two groups. The formula of Saphiro Wilk below was used to test the normality in SPSS 17.0

$$q = \frac{w}{s}$$

Where is the test statistic, w is the range of the data and s is the standard deviation

e. Homogeneity

Homogeneity test aims to determine whether the measured score variance in both samples has the same variance or not. Populations with the same variance are called populations with homogeneous variance, whereas populations of unequal variance are called populations with heterogeneous variance (Hafizah, 2000).

f. T Independent

Independent sample T test was used to test the significance of the average difference of the two groups. This test is used to test the effect of the independent variable to the dependent variable. The significance value is 0.05 and determines the hypothesis.

$$t = \frac{M_x - M_y}{\sqrt{\left(\frac{\sum X^2 + \sum Y^2}{N_x + N_y - 2}\right)\left(\frac{1}{N_x} - \frac{1}{N_y}\right)}}$$

(Arikunto, 2010)

Where:

M_x = mean from the difference of pretest and post-test in experiment class

M_y = mean from the difference of post-test in control class

$\sum X^2$ = the total of deviation square in experiment class

$\sum Y^2$ = the total deviation square in control class

N_x = subject of the sample of both experiment class

N_y = subject of the sample of both control class

3.8.2 Questionnaire

The questionnaire that used to measure student' motivation is adapted from International Journal and COLDEX. The questionnaire was used liker scale where the scale consist of several choice there are "strongly agree, agree, not sure, disagree, and strongly disagree". The data was taken from students in both of control and experimental group. The questionnaire was given to the students in the end of teaching-learning activity. The questionnaire consists of 30 questions divided into three topics, there is solar system topic, technology topic and stellarium, each topic consists of positive statement and negative statement.

The data was analyzed to get the total score of each student whether students has a high motivation or not. The second is calculating the average percentage of each statement to know where the students have high or low motivation. The researcher use Microsoft Excel to analyzed the data. To know the criteria of students motivation researcher use interval classification while for each statement researcher interval percentage. Below is formula to get the interpretation of motivational questionnaire.

a. Students Motivational Classification

1. Determine how many categories we want (three categories: high, medium, low or five categories: very high, high, medium, low, and very low).
2. Determine the highest value (XT) that might be achieved by subject = 30 (item) x5 (highest score per grain scale) = 150
3. Determine the lowest value (XR) that might be achieved by the subject = 30 (item) x1 (the lowest value of each grain scale) = 30
4. Determine R (Span) = XT- XR = 150 - 30 = 120 . If three classifications, then each classification interval = 120: 3 = 40. If five classifications, then each classification interval = 120: 5 = 24
5. Determine M (average) = (30 + 150): 2 = 90 (Haryono, 2017)
6. Determine the values of classification limits as below

Table 3.10 Interpretation Students Motivation

Interval	Classification
If Total Score > 110	High Motivation
If 70- 110	Adequately Motivation
If Total Score < 70	Low Motivation

Source : Haryono, 2017

b. Interval Formulation

I = 100 / Total Score (likert)

Then = 100/5 = 20, Result (I) = 20 (This is the distance interval from low 0% to 100% high) The following interpretation criteria scores are based on the interval: (Darmadi, 2011)

Table 3.11 Interpretation Motivational Questionnaire

Interpretation Table	
0% - 19.99%	Very (disagree / bad / less once)
20% - 39.99%	Disagree / Unfavorable)
40% - 59.99%	Fair / Neutral
60% - 79.99%	(Agree / Good / like)
80% - 100%	Very (agree / Good / Likes)

Source : Darmadi, 2011

3.9 Research Procedure

There are three stages of this research procedure. The stages are preparation; implementation; and completion stages. Those three stages will be explained as follows:

1. **Preparation Stage**

   In this stage, the researcher conducts several steps that research. The Steps are:

   a) Formulate problem that is going to be investigated
   b) Determine the focus of variable research
   c) Conduct literature review of Interactive Multimedia, students' motivation, and students understanding.
   d) Arrange the research proposal which will be presented in proposal seminar.
   e) Consult to expertise and lecture
   f) Present research proposal in proposal seminar
   g) Revise research proposal after having suggestions and critics from lectures.
   h) Arrange research instrument and ask expert to judge it.
   i) Revise research instrument that has been judge.
   j) Try out research instrument
   k) Revise research instrument based on the result of instrument try out analysis.

2. **Implementation Stage**

   This stage explains steps of how research will be implemented. The steps consist of

   a) Determination of experimental class.
   b) Give pre-test to class. The purpose is to gain information of initial condition of class.
   c) Analyze result of pre-test.
   d) Conduct research activity by implementing *stellarium* as interactive multimedia in learning solar system.
   e) Give post-test to class. The purpose is to gain information of students' improvement in creativity and concept mastery.
   f) Give questionnaire to know students' motivation towards implementation of *stellarium* in learning process.

3. **Completion Stage**

   The steps will be conducted in this final stage are:

   a) Analyze the result of the whole research

b) Discuss and conclude for the data analysis result

c) Arrange the report of the research

d) The schema of research stage is shown in figure 3.1

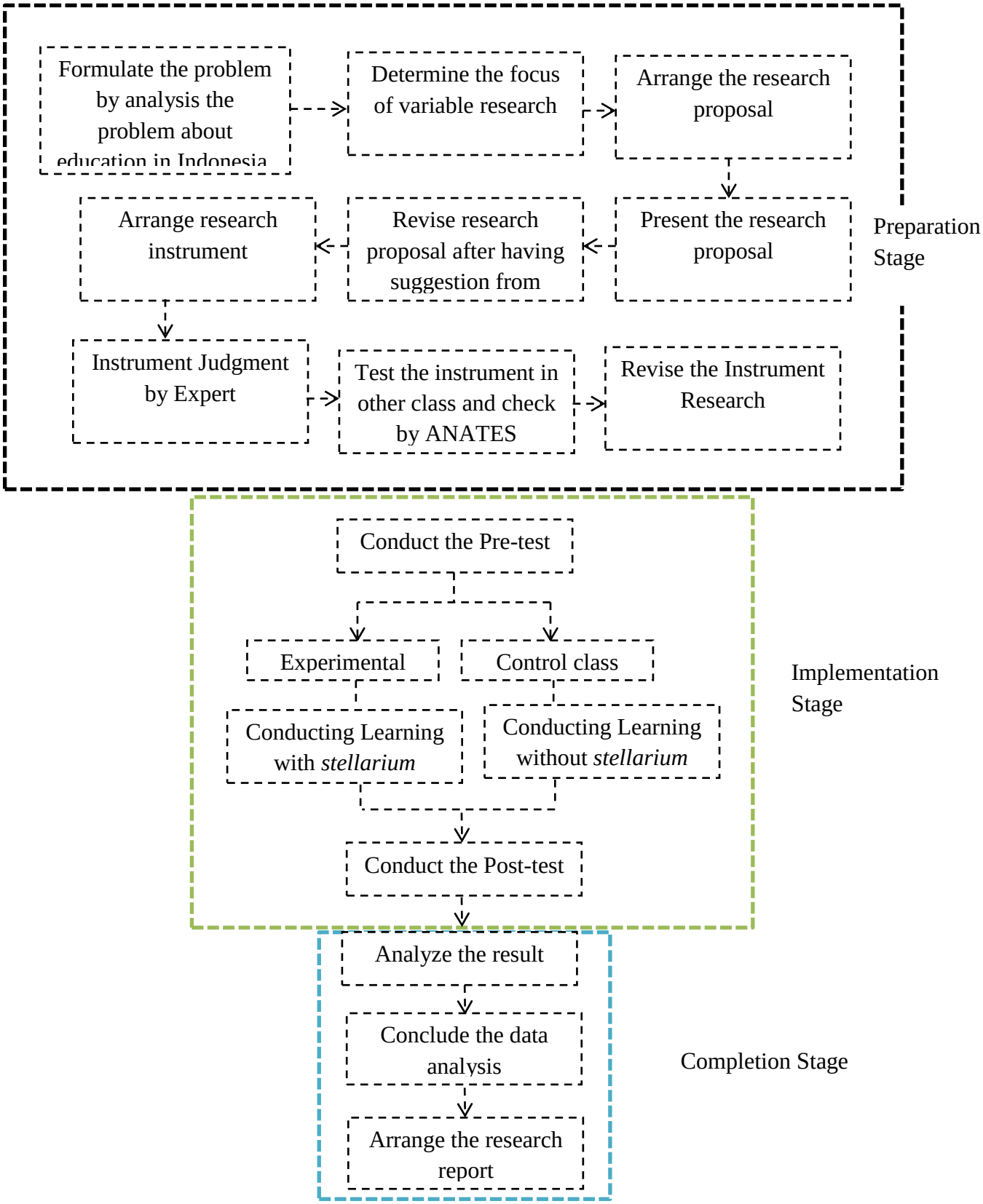

Figure 3.1 Schema of Research Stage