

CHAPTER II

REVIEW OF RELATED LITERATURE

This part discusses the nature of speaking, problems in speaking, teachers' problems in teaching speaking, teaching speaking to EFL students, speaking process, accuracy, corrective feedback, teachers' role, experimental design, ANOVA.

A. The Nature of Speaking

There are many definitions of speaking that have been proposed by some experts in language learning. Brown cites that when someone can speak a language it means that he can carry on a conversation reasonably competently. In addition, he states that the benchmark of successful acquisition of language is almost always the demonstration of an ability to accomplish pragmatic goals through an interactive discourse with other language speakers.¹

Richards and Renandya state that effective oral communication requires the ability to use the language appropriately in social interactions that involves not only verbal communication but also paralinguistic elements of speech such as pitch, stress, and intonation. Moreover, nonlinguistic elements such as gestures, body language, and expressions are needed in conveying messages directly without any accompanying speech. Brown states that social contact in interactive language functions is a key importance and in which it is not what you say that

¹ Erita Budi Pratiwi, "*Improving the Speaking Skill of the Tenth Grade Students at SMA Berbudi Yogyakarta by Using Videos*", Unpublised Theseis, Yogyakarta: Universitas Negeri Yogyakarta, 2012, p. 7.

counts but how you say it what you convey with body language, gestures, eye contact, physical distance and other nonverbal messages.²

In their discussion on the nature of spoken language, Brown and Yule in Nunan distinguish spoken language from written language. They point out that for most of its history. The teaching of language has not been concerned with spoken language teaching. This language comprises short, often fragmentary utterances, in pronunciation range. On the contrary, written language is characterized by well-formed sentences which are integrated into highly structured paragraphs. Brown and Yule in Nunan also differentiate between two basic language functions, i.e. the transactional and the interactional functions. The former basically concerns the transfer of information. According to Nunan successful oral communication involves³:

1. The ability to articulate phonological features of the language comprehensibly.
2. Mastery of stress, rhythm, intonation patterns.
3. An acceptable degree of fluency
4. Transactional and interpersonal skills
5. Skills in taking short and long speaking turns.
6. Skills in the management of interaction.
7. Skills in negotiating meaning
8. Conversational listening skills (successful conversations require good listeners. as well as good speakers).
9. Skills in knowing about and negotiating purposes for conversations.

² H. Douglas Brown, *Teaching by Principles (An Interactive Approach to Language Pedagogy)*, (California: Longman, 2000). p. 237.

³ Erita Budi Pratiwi, *Improving the Speaking Skill...*, p. 8.

10. Using appropriate conversational formulae and fillers.

Moreover, he states that the teacher can apply the bottom-up-top-down approach to speaking. The bottom-up approach to speaking means that the learners begin with the smallest units of language, i.e. individual sounds, and move through the mastery of words and sentences to discourse. The top-down view, on the other hand, proposes that the learners start with the larger chunks of language, which are embedded in meaningful contexts, and use their knowledge of the contexts to comprehend and use the smaller language elements correctly. Brown adds in teaching oral communication, micro skills are very important. One implication is the importance of focusing on both the forms of language and the functions of the language.⁴ He also mentions that the pieces of language should be given attention for more that make up to the whole. Furthermore he mentions micro skills of oral communication:

1. Produce chunks of language of different lengths.
2. Orally produces differences among the English phonemes and allophonic variants.
3. Produce English patterns, words in stressed and unstressed positions rhythmic structure, and into national contours.
4. Produce reduced forms if words and phrases.
5. Use an adequate number of lexical units (words) in order to accomplish pragmatic purpose.
6. Produce fluent speech at different rates of delivery.

⁴ *Ibid*, p. 9.

7. Monitor your own oral production and use various strategic devices pauses, fillers, self-corrections, backtracking- to enhance the clarity of the message.
8. Use grammatical word classes (nouns, verbs, etc), system (e.g. tense, agreement, and pluralization), word order, patterns, rules, and elliptical forms.
9. Produce speech in natural constituent in appropriate phrases, pause groups, breath groups, and sentences.
10. Express a particular meaning in different grammatical forms.
11. Use cohesive devices in spoken discourse.
12. Accomplish appropriately communicative functions according to the situation, participants and goals.
13. Use appropriate registers, implicative implicative, pragmatic conventions, and other sociolinguistics features in face to face conversations.
14. Convey links and connections between events and communicate such relations as main idea, supporting idea, new information, given information, generalization, and exemplification.
15. Use facial features, kinetics, body languages, and other non verbal cues among with verbal language to convey meanings.
16. Develop and use a battery of speaking strategies such as emphasizing key words, rephrasing, providing a context for interpreting the meaning of words, appealing for help, and accurately assessing how well interlocutor is understanding you.⁵

⁵*Ibid.*,p. 9.

From some definitions above it can be concluded that speaking skill is always related to communication. Speaking skill itself can be stated as the skill to use the language accurately to express meanings in order to transfer or to get knowledge and information from other people in the whole life situation.⁶

B. Problems in Speaking

The same characteristics must be taken into account in the productive generation of speech, but with slight twist in that the learner is now the producer. Bear in mind that the following characteristics of the spoken language can make oral performance easy as well as, in some cases, difficult.⁷

1. Clustering

Fluent speech is phrasal, not word. Learners can organize their output both cognitively and physically (in breath groups) through such clustering.

2. Redundancy

The speaker has an opportunity to make meaning clearer through the redundancy of language. Learners can capitalize on this feature of spoken language.

3. Reduced forms

Contractions, elisions, reduced vowels, etc., all form special problem in teaching spoken English (see the section below on teaching pronunciation). Students who don't learn colloquial contractions can sometimes develop a stilted, bookish quality of speaking that in turn stigmatize them.

⁶ *Ibid*, p. 10.

⁷ A'am Rifaldi Khunaifi, "*The Students' Difficulties in Learning Speaking English for the Second Year Students at MAN Model Palangka Raya*", Unpublished Thesis, Palangka Raya: Stain Palangka Raya, 2009, p. 23.

4. Performance Variable

The advantages of spoken language is that the process of thinking as you speak allows you to manifest a certain number of performance hesitations, pauses, backtracking, and corrections. Learners can actually be taught how to pause and hesitate. For example, in English our “thinking time” is not silent; we insert certain “fillers” such as *uh, um, well, you know, I mean, like, etc.* one of their most salient differences between native and nonnative speakers of a language is in their hesitation phenomena.

5. Colloquial Language

Make sure your students are reasonably well acquainted with the words. Idioms, and phrases of colloquial language and that they get practice in producing.

6. Rate of delivery

Another salient characteristic of fluency is rate of delivery. One of your tasks in teaching spoken English is to help learners achieve an acceptable speed along with other attributes of fluency.⁸

7. Stress, rhythm, and intonation

This is the most important characteristic of English pronunciation. The stress-timed rhythm of spoken English and its intonation patterns convey important messages.⁹

C. Teachers’ Problems in Teaching Speaking

1. The “Students won’t talk” problem

⁸ *Ibid*, p. 24.

⁹ *Ibid*, p. 25.

EFL teachers point out that some students, including advanced students, are so shy or have such high levels of anxiety over speaking that they will not speak in class. This is not only true for beginners, but also for some students who are fairly advanced in their listening, reading and writing abilities. Perhaps they are anxious because they have not had many chances to speak or because teachers in the past have been critical of their English. Whatever the reason, when faced with quiet anxious students, the problem for conversation teacher is how to get them to open up, to talk.

Before anything else, as teachers, we need to gain the trust of the students. To gain the trust, the students need to know that we are on their side. They need to know that we do not expect them to speak perfect English, and that we realize it takes time and effort for them to learn to converse in English.

As teachers, we also need to provide opportunities for students to feel at ease in the classroom. One way to do this is through warm-up activities. In fact, the objective of using warm-up activities is to relax students, to help get them over their classroom apprehensions. There are, of course, a great number of possible ways to warm students up for conversation class.¹⁰

One way is through the use of techniques used by drama teachers. Here are a few examples:¹¹

a. A Breathing Warm-Up Exercise

¹⁰ Jerry G. Gebhard, *Teaching English as Foreign or Second Language (A teacher Self-Development and Methodology Guide)*, United States of America: The University of Michigan Press, 2000, p. 186-187.

¹¹ *Ibid*, p. 187-188.

The students and the teacher close their eyes, breathe slowly in through their noses for three seconds, hold that breath for nine seconds, then slowly release it through their mouths for six seconds. This is repeated several times.

b. Walking Warm-Up Exercise

The teacher and the students clear away furniture from the center of the room. While standing, they form a circle. They then begin to walk in a circle in their usual way. After a turn or two around the circle, the teacher then calls out commands, such as “Walk like you are chest high in water,” “Walk on clouds,” “Walk like you were a marionette,” and “Walk like you are on hot sand”.

c. A voice Warm-Up Exercise

While sitting or standing on a circle, the teacher begins by whispering a word or phrase, for example, “Hello!” the next person says the word a little louder, but still in a whisper, the next a little louder, and so on, until the word comes back to the teacher, perhaps even as shout. A variation is to slow down or speed up the way the word or phrase is said.

The use of quasi-communication activities, such as dialogue practice, can also engage “quiet” students in speaking. As students can rely on context and print, they are sometimes more willing to speak.¹²

2. The “error treatment” problem

Most EFL/ESL teachers now believe that students need to be given an acquisition rich experience in the classroom, providing them with opportunities to listen to, read, write and speak lots of English. Some of these teachers also believe

¹² *Ibid*, p. 188.

that students will naturally acquire the language through unconscious process of second language acquisition. As long as language input is comprehensible to the students, they will acquire the grammar of the language on their own. Many of those who believe in acquisition point to the research on the acquisition of grammar by second language learners.¹³

This research shows that some grammatical features are acquired early and others later for learners. Like wise ability, the ability to use irregular past tense of verbs, such as ate, slept, drank, and swam, is acquired before regular past tense. Some acquisition believers point out that error treatment will do little to change this natural process.

However, others believe that feedback on language errors can be used as a type of input by students to promote the acquisition process. In short, some educators suggest that error treatment through the different stages of acquisition, especially in EFL settings where the students do not have access to lots of authentic language outside classroom.

Taking this controversy into consideration, as EFL/ESL teachers, we have choices. We can decide not to treat language errors, or we can decide to treat them. If we decide to treat them, then there are other decisions that need to be made like when errors should be treated, which errors should be treated, who should treat them, how they can be treated.¹⁴

¹³ *Ibid*, p. 189.

¹⁴ *Ibid*, p. 190.

D. Teaching Speaking to EFL Student

The most people, mastering the art of speaking is the single most important aspect of learning a second or foreign language, and success is measured in terms of the ability to carry out conversation in the language. The ESL teacher's growing concern over communication is largely a reaction against the most extreme practices of the audiolingual method, which tended to dichotomize language structure and content. The behaviorist theory of learning on which this method was based stressed the development of automatic. Conditioned responses to teacher-directed cues. Memorization of short dialogues and oral repetition of controlled structural drills became the activities through which students gained phonological and syntactic habits. It was assumed that students would be able to infer general rules and patterns from the model sentences drilled and thus extend their control by recognizing semantic and structural similarities which had never been explicitly presented to them. However, teachers found to their horror that students who could flawlessly repeat classroom dialogues were unable to speak in analogues contexts.¹⁵

A considerable number of articles discuss specific methods by which teachers might develop lots of examples for teaching students to communicate more effectively. The majority depends upon the fact that in order to increase what West terms IPTT (individual pupil talking time), the teacher must concern with development of student-to-student inter interaction. This section specifically intends to discuss classroom activities that aim at encouraging communication or

¹⁵ Endang Fauziati, *Teaching of English a Foreign Language (TEFL)*, Surakarta: 2001, p. 126-127.

interaction among students. The activities discussed here are only ways of getting students to talk to teach in pairs or in groups. They also aim to stimulate discussion and information-trading transaction. The activities may include role playing, games, problem-solving, songs, and discussion.

Role playing is creating dramatic situation in a classroom, or in a part, simply acting out dialogues, but also in part relabeling objects and people in the room to prepare for imaginative role playing. A role playing can help teachers to expand the classroom indefinitely and provide natural context for their dialogue being used.¹⁶

Game is one of activities which can help to create dynamic, motivating classes. The reason is that real learning takes place when the students, in a relaxed atmosphere, participate in activities that require them to use what they have been drilled on.¹⁷

Materials which focus on problem solving offer further opportunities for students to work in pairs or small groups, to share information and opinion topics, which are meaningful to them.¹⁸

Using song in EFL classroom, especially speaking one can be both enjoyable and educational. Songs usually provides a peaceful and happy mood for the listeners.¹⁹

E. Speaking Process

¹⁶ *Ibid*, p. 127.

¹⁷ *Ibid*, p. 130.

¹⁸ *Ibid*, P. 133.

¹⁹ *Ibid*, P. 135.

As students actively engage in the speaking process, their perceptions can change from moment to moment and from week to week. As individuals acquire new information, the language they use to make meaning changes. As they reflect upon information shared or received, they revise their understanding, further developing their schemas about language and the world. The speaking process includes activities that occur prior to, during, and after the actual speaking event. For example, before speaking, the speaker might determine the actual content of the message, how it should be presented, and what kind of audience will be hearing the message. While speaking, the speaker must attend to such things as presenting a clear message, tone of voice, suitable vocabulary, possible responses, the environment, and nonverbal gestures. Following speaking, the speaker might accept comments, answer questions, explain concepts not understood, and assess the process.²⁰

1. Pre-speaking: Planning and Organizing

Only as pre-writing precedes drafting, pre-speaking begins before students actually speak. Students' experiences, observations, and interactions inside and outside of the classroom have an impact upon what they say and how they say it. Pre-speaking activities involve thought and reflection, and provide opportunities for students to plan and organize for speaking.

2. Speaking

Speaking actively engages students in interactions with peers and other audiences. Students who have been provided with supportive, collaborative

²⁰ Nanik Halimah, "*The Competency of Speaking*", Unpublished Thesis, Palangkaraya: STAIN Palangka Raya, 2009, p. 21.

environments and opportunities to prepare for their informal and formal speaking experiences are more likely to have the confidence needed to "go public" with their ideas and information. In order to communicate and interact with others, students need to engage in a variety of formal and informal speaking situations, depending upon their purpose for speaking.

3. Post-speaking

Following speaking experiences, both formal and informal, it is important to have students reflect upon their performance. Their reflection, whether it is oral or written, should include the teacher, who can help them set personal goals for improving their speaking abilities. This type of reflective assessment and goal setting encourages critical thought.²¹

F. Accuracy

Though the criteria for defining accuracy in most standardized tests include factors such as grammar, vocabulary, pronunciation, sociolinguistic competence, or pragmatic competence, grammatical errors were the main factors in deciding the level of accuracy for this research. Considering the fact that grammatical instruction has been mainstream in English education in Indonesia, it is important to investigate the learners' accuracy under the instruction of communication based lessons. The word usage and sentence structure were considered as grammatical understanding.²²

²¹ *Ibid*, p. 23-26.

²² Kouichi Ano, *Fluency and Accuracy in the Spoken English*, Unpublished Book, Waseda: Waseda University, 2012, p. 11.

G. Corrective Feedback

1. Definition of feedback

The definition of corrective feedback. It is necessary to state that errors are a natural part of the learning process. Errors are common characteristic of language acquisition and learning. That is to say everyone will make errors in the process of learning no matter learning the first language or the second language. However, in second language classroom, teacher usually wants students to speak as much as possible and encourage them to speak with the purpose of improving communication competence. When students speak SL they will also make various errors, and if these errors are not corrected, students will mistake them for correct form and internalize them to their interlanguage system. So, the oral English will be easy to fossilize if teacher do not provide corrective feedback. Lightbown and Spada give corrective feedback definition such as: Any indication to the learners that their use of the target language is incorrect. The learners receive various responses. For example, When a language learner says, 'He go to school everyday', corrective feedback can be explicit, for example, 'no, you should say goes, not go' or implicit 'yes he goes to school every day', and may or may not include metalinguistic information, for example, 'Don't forget to make the verb agree with the subject'. In the following part will introduce six types of corrective feedback with examples.²³

²³ Ruili Chu, "*Effects of Teacher's Corrective...*". p. 457.

Tamasello and Herron (1992) suggest that some activities should be designed so that learners make error and then get immediate feedback to make them aware of the gaps in their knowledge.²⁴

Ellis (2009). Ellis points out that direct feedback provides explicit guidance to the learners about their errors and it is particularly helpful to those learners who are not capable of self-correcting the errors.²⁵

According to Leki (2006) Feedback helps to create a supportive teaching environment and provides one form of 'socioacademic interaction'. It can provide learners the guidance and assurance that they are on the right track and offer indications of which track to get on if they are not).²⁶

Day, et al. employ corrective feedback to refer to the native speakers' response to what they perceived to be errors committed by non-native speakers. The definition has its limitations, the provider of corrective feedback only non-native speakers, in fact it includes all the people, native-speaker or non-native speaker. Corrective feedback does not just emphasize the form of language just like the traditional teaching method; it draws students' attention to linguistic forms as they arise incidentally in lessons whose overriding focus is on meaning or communication.

2. Types of Corrective feedback

The classification of corrective feedback. When studying corrective feedback and learner uptake in four French immersion classrooms at the primary

²⁴ Nation and Jonathan Newton, "*Teaching ESL/EFL Listening and Speaking*".(New York: Routledge. 2008). p. 140.

²⁵ Moniruz Zaman and Abul Kalam Azad, "*Feedback in EFL Writing at Tertiary Level (Teachers' and Learners' Perceptions)*", ASA University, Vol. 6 No. 1, p.1. 2012.

²⁶ *Ibid*, p.1.

level. Ruili Chu in Lyster & Ranta divides the corrective feedback to be two types. The first one can be self-repair (elicitation, metalinguistic feedback, clarification request, repetition). The second one is self- correct (explicit correction and recast).²⁷

- a. ***Explicit correction***: teachers supply the correct form and clearly indicate that what the students say is incorrect.

The example:

Student: he take the bus to go to school.

Teacher: oh, you should say he takes. he takes the bus to go to school.

- b. ***Recast***: teacher implicitly reformulates all or part of the student's Utterance.

Student: he take the bus to go to school.

Teacher: he takes the bus to go to school.

- c. ***Elicitation***: teacher directly elicits a asking questions or by pausing to allow students to complete teacher's utterance, or asking students to reformulate their utterance.²⁸

Student: he take the bus to go to school.

Teacher: he?

Teacher: how do we form the third person singular form in English?

Teacher: can you correct that?

- d. ***Metalinguistic feedback***: to the well-formedness of the student's utterance.

Student: he take the bus to go to school.

Teacher: do we say *he take*?

²⁷ Ruili Chu, "Effects of Teacher's Corrective...". p. 460.

²⁸ *Ibid.* p. 459.

Teacher: How do we say when it forms the third person singular form?

e. **Clarification request**: teacher's request for further information from a student about a previous utterance.

Student: he take the bus to go to school.

Teacher: parden me?

f. **Repetition**: teacher repeats the student's ill-formed utterance, adjusting intonation to highlight the error.

Student: he take the bus to go to school.

Teacher: he take?

H. Teacher's Roles

How we structure the classroom is an important, perhaps the most important, form of communication we make to students. If we structure so that the teacher is full control of what and how students study, we communicate that students are empty or that their intelligence and curiosity are not valued. If we choose an autocratic authority structure, we communicate a lack of faith in the potential of students to choose positive directions for development. By taking full responsibility for students' learning, we leave them none.

Little wood supports what has been said in the previous paragraph saying that especially in the more creative types of activity, unnecessary intervention on the teacher's part may prevent the learners from becoming genuinely involved in the activity and thus hinder the development of their communicative skills. However, this does not mean that once an activity is in

progress, the teacher should become a passive observer. His function becomes according to Little wood less dominant than before, but no less important.²⁹

Most students will not engage in an interaction by themselves unless the teachers start first. Obviously, the role of the teacher is very crucial in motivating and creating interest in the topics. The basis of the communicative approach is this capacity of the teacher to adapt himself, to change roles. Hedge Tricia identifies important roles the teachers can play, “As controller in eliciting nationality words; as assessor of accuracy as students try to pronounce the words; as corrector of pronunciation; as organizer in giving instructions of the pair work, initiating it, monitoring it, and organizing feedback; as promoter while students are working together and as resource if students need help with words and structures during the pairwork”.

1. Controller: within a classroom interaction and especially learner-teacher interaction, the teacher is the responsible for the teaching and learning processes. Harmer asserts that the teacher job here is to transmit knowledge from himself to his students.

2. Assessor: the most expected act from the teacher is to show the learners that their accuracy is being developed. Harmer says that this is done through giving correction or by praising them. The students have to know how they are being assessed; the teacher should tell them their strengths and weaknesses, the students, then can have a clear idea about their levels and what they need to concentrate on.

²⁹ Pavlina Bercikova, “*Teacher’s Role in Pair Work*”, Unpublised Thesis, Brno: Masaryk University, 2007, p. 29.

The assessor teacher should pay attention also to the learners' reactions and how to deal with them.³⁰

3. Corrector: the teacher has to decide when and where to correct students' production. Another important point is that the teacher should be careful when correcting pronunciation mistakes or errors the learners commit during classroom interaction, i.e. he works seriously to give the correct pronunciation, form or meaning because the learners very often acquire these issues from their teachers.

4. Organizer: it is the most important role according to Harmer that the teacher acts in a classroom where many things must be set up such as organizing pair or group work, giving learners instructions about how well they interact, and finally stopping everything when the time is over. The teacher in such a role spends much time in engaging all the class in the interaction and ensures its participation. Once the students are involved in the interaction, the teacher can stop interacting and let the learners speak and listen to each other, exchange views and why not correct each others too.

5. Prompter: Sometimes the learners do not find the words when they talk to each others or with the teacher, the role then of the latter is to encourage the learners to think creatively so that to be independent from the teacher. In such role, the teacher must prevent himself to help the students even if he wants so that they will be creative in their learning.³¹

6. Resource: the job of the teacher here is to answer students' questions. For example, when they want to know how to say something or when they look for

³⁰ *Ibid*, p. 29.

³¹ *Ibid*. p. 29.

the meaning of a given word or phrase, they go back to their teacher as a resource of information. In turn, the teacher should be able to offer such needed information.³²

I. Experimental Design

Experiment is a scientific investigation in which researcher manipulates one or more independent variables, controls are any other relevant variables, and observes the effect of the manipulation on the independent variable. An experimenter deliberately and systematically introduces change and then observes the consequences of the change. Only research problem that permit a researcher to manipulate conditions are appropriate for experimental research. The goal of experimental research is to determine whether a causal relationship exists between two or more variables. Because the experiment involves control and careful observation and measurement, this research method provides the most convincing evidence of the effect that one variable has on another.

Early scientists learned the value of observation in the study of our environment but soon realized that nature's complexity could not always be understood through simply observing its many events. They found that events occurring in their "natural" state were often so complicated by irrelevant factors that the operation of the factor they wished to study was obscured. They solved the difficulty by controlling the conditions under which occurred so that the irrelevant factors were eliminated. Then they could deliberately manipulate the

³² Kouicem Khadidja, "*The Effect of Classroom Interaction on Developing the Learner's Speaking Skill*", Unpublished Thesis, Algeria: Mentouri University-Constantine, 2010, p. 19-21.

independent variables of interest and measure the changes in the dependent variables that resulted from changes in the independent variables. In other words, they began to perform experiments.³³

In its simple form, an experience has *three* characteristics: (1) An independent variable is manipulated; (2) All other variables that might affect the dependent variable are held constant; and (3) The effect of the manipulation of the independent variable on the dependent variable is observed. Thus, an experiment the two variables of major interest are the independent variable and the dependent variable. Independent variable is manipulated (changed) by the experimenter. The dependent variable is so named because its value is hypothesized to depend on, and vary with, the value of the independent variable. For example, to examine the effect of different teaching methods on achievement in reading, an investigator would manipulate method (independent variable) by using different teaching methods in order to assess their effect on reading achievement (the dependent variable).³⁴

J. ANOVA

Simple or one-way analysis of variance (ANOVA) is a statistical procedure used to analyze the data from a study with more than two groups. The null hypothesis is that there is no difference among the group means. It is called one-way ANOVA because there is only one independent variable and one dependent variable. In analysis of variance, as in the t test, a ratio comparing observed differences to the error term is used to test hypotheses about differences

³³ Donald Ary, et al., *Introduction to Research...*, p. 265-266.

³⁴ *Ibid*, p. 266.

among groups. This ratio, called the F ratio, employs the variance (σ^2) of group means as a measure of observed differences among groups. The F ratio is named for R. A. Fisher, the early statistician who developed it. Because ANOVA can be used with more than two groups, it is a more versatile technique than the t test. A t test can be used only to test a difference between two means.³⁵

ANOVA can test the difference between two or more means. The general rationale of ANOVA is that the total variance of all subjects in an experiment can be subdivided into two sources: variance between groups and variance within groups. Variance between groups is incorporated into the numerator in the F ratio. Variance within groups is incorporated into the error term or denominator, as it is in the t test. As variance between groups increases, the F ratio increases. As variance within groups increases, the F ratio decreases. The number of subjects influences the F ratio: The larger the number, the larger the numerator becomes. When the numerator and denominator are equal, the differences between group means are no greater than would be expected by chance alone. If the numerator is greater than the denominator, you consult the table of F values to determine whether the ratio is great enough to let you reject the null hypothesis at the predetermined level. Computing the F Ratio (simple analysis of variance) Suppose you have the three experimental conditions of high stress, moderate stress, and no stress, and you wish to compare the performance on a simple problem-solving task of three groups of individuals, randomly assigned to these three conditions.

³⁵ *Ibid*, p. 178-180.

One can compute the F ratio by following the required steps. The first step is to find the sum of the squared deviation of each of the individual scores from the grand mean. This index is called the “total sum of squares” and reflects all treatment effects plus sampling error.³⁶ It is expressed by the following formula :

$$SS_t = \sum_t^2 - \left(\frac{(\sum_t)^2}{N} \right)$$

Where

SS_t = sum of squares total

$\sum X^2$ = each score squared, then summed

$(\sum X_t)^2$ = all the scores summed first, then this sum squared

N = number of scores

Next, find the part of the total sum of squares that is due to the deviations of the group means from the grand mean. This index is called the “sum of the squares between groups.” (To be grammatically correct, we should say “the sum of squares *among* groups” when more than two groups are involved. However, it is a long-standing tradition to use the term “sum of squares between groups,” and to be consistent with other texts we are retaining this usage here.)

This index is found by applying the formula:

$$SS_b = \sum_b^2 - \left(\frac{(\sum_t)^2}{N} \right)_1 + \left(\frac{(\sum_t)^2}{N} \right)_2 - \left(\frac{(\sum_t)^2}{N} \right)$$

Then, find the part of the total sum of squares that is caused by the deviations of each individual score from its own group mean. This index, called

³⁶ *Ibid*, p. 180

the “sum of the squares within groups,” is found by applying the raw score formula for the sum of squared deviations to each group and then summing across groups ($SS_w = SS_1 + SS_2 + \dots$).³⁷

³⁷ *Ibid*, p. 180