

# Using Fuzzy Statistical Analysis Compares Students' Perception between Ethnic Majority and Ethnic Minority

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**Abstract**—The purpose of the research mainly compares ethnic majority and ethnic minority students' perception in secondary school. The research used fuzzy statistical analysis to be a research tool. The participants were 64 ethnic majority students and 21 ethnic minority students. The findings are as follows. 1. The two groups of students have the same opinion on item 1 and item 3, but they have different opinions on the other items. The ethnic majority students have more positive attitude toward the statements of the items than the ethnic minority students. 2. The highest ranking of all items is strongly agree of item 3, no matter they are ethnic majority or ethnic minority students. 3. There are significant differences between ethnic majority and ethnic minority students on strongly agree of item 2 and on no opinion of item 6. Some suggestions are made for teachers, parents, and students.

**Index Terms**—Ethnic majority, ethnic minority, fuzzy statistic, perception.

## I. INTRODUCTION

Generally, the public primary and secondary schools might have aborigines and new residents. The aborigines refer to children whose father/mother or both are aborigines, and new residents usually refer to children who were born by foreign brides. A few years ago, there were many foreign brides getting married with the native men. So the numbers of new residents in recent years increase, especially in primary and secondary schools.

Students may be at the same class with classmates of different races. They inevitably have the opportunity to contact with each other. Is their performance different, especially in academic performance and peer relationships? In order to understand the performance of students of different races, investigating students' perception is important. Through knowing students' perception on teachers' attitude, their own performance and their family, then compares the perception of different races.

### A. Literature review

A researcher [1] investigated whether teachers have different standards on rating ethnic majority and ethnic minority students. He found out that the prejudice does not exist. He did an experiment and found that there was no direct evidence to the score bias. He also found that the indirect evidence to the score bias might cause the performance of students below their ability level, such as teachers have lower expectations to ethnic minority students, and adopt more unfavorable attitude to them.

It is very important for teachers rating the level of

students. Generally, the scores of students came from the test scores, but teachers' assessment criteria and other factors may affect students' motivation, self-confidence and learning results [2]. The process of scoring is often subjective, and the score targets are often set by teachers. There are many factors, including personal favorite, group stereotypes and the appearance of attractiveness might affect the rating. There are researches indicate that teachers' ratings are bias may cause a particular group of students to be injury, and these groups may be victims due to gender, race or socio-economic status [3]. For example, a researcher [4] found that ethnic minority students' scores are lower because their teachers are the ethnic majority.

Although the background factors can explain differences of students' achievement, such as parental education level, income differences and the quality of different schools, but there are still other factors [5]. A researcher [4] indicated that students' achievement gap in part came from teachers. A researcher [6] found that teachers believed that ethnic minority students were more destructive, more casual, and less will do their homework. He explained it from three aspects: poor performance may result in deterioration of student behavior; poor student behavior may be caused by the behavior of teachers, including teachers treat them unjust; or deviant behavior may be only because teachers identify cognitive prejudices.

Some researchers [7] pointed out that in classes if there were a considerable proportion of ethnic minority students, regardless of the ethnic majority or ethnic minority students, the ethnic majority students said that the attitude to the foreign ethnics might be negative. A researcher [8] indicated that when the perception of race affects people's sense of achievement (e.g., work objectives), sense of belonging (e.g., the consistency of groups), and sense of equality (e.g., procedural justice), the interaction between these races will be less harmony. The problems would be more serious, when it mixed with other types of differences, such as information and values different. Especially the number of majority and minority ethnic disparities or racial differences is large, so the race interaction would be poorer.

From the above literature we can see that teachers have a great impact on students. Some researches indicted that teachers gave lower score to ethnic minority students, but some researches had different results. If teachers have bias attitude to ethnic minority students, students can feel that clearly. It would affect their performance in various aspects of learning. So teachers must know their influence on students and avoid judging students by their races.

### B. The Related Theory

#### 1) Contact theory

A researcher's [9] theory of contact indicted that people

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contact with the foreign members of the group will reduce the negative attitude to foreign groups. The mechanisms of contact relationship in groups and out groups are different. In the aspect of cognition, the contact between different ethnic groups will have more understanding to other ethnic groups, more correct perception, and bias will be less [10]. In the aspect of affection, such exposure can reduce the tension between different ethnic groups, and express their views more easily [11]. The class of school is a microcosm of society, and students' contact is unavoidable [12]. In class, students have opportunities to access to different ethnic groups, and they can help reduce the negative attitudes. However, some researchers [13] indicate that contact between different ethnic groups will obviously reduce the different groups of negative attitudes, but it should be in appropriate circumstances. It may include the status of equal, mutual assistance and cooperation, common goals, and institutional supports [9].

2) Ethnic competition theory

In contrast with the contact theory, the theory of ethnic competition [14] noted that the increasing numbers of ethnic minority members would increase the sense of crisis [15]. It could easily make ethnic majority have negative attitudes to ethnic minority. The researches of Europe have showed the same result. In Europe, the proportion of ethnic minorities increased, and it made the ethnic majorities produce negative attitude to them [16].

These two theories have their reasons. They seem contrary to each other, but actually they have different points of view on racial issues. If we can see things from different angles and consult other people's opinions, we can look at things more objectively and have more profound understanding to them.

II. RESEARCH METHOD

A. Fuzzy Statistics

Fuzzy numbers can resolve many problems of life, especially in making decisions. It is not the alternative or traditionally chooses one from multiple options, but according to their wishes give scores at all options. After collecting the scores of the members, the best decision can be made. This decision is often the best decision that matches most people's wishes.

Definition.1. Fuzzy Numbers

Let  $U$  be a universal set,  $A = \{A_1, A_2, \dots, A_n\}$  be the subset of discussion factors in  $U$ . For any term or statement  $X$  on  $U$ , its membership corresponding to  $\{A_1, A_2, \dots, A_n\}$  is  $\{\mu_1(X), \mu_2(X), \dots, \mu_n(X)\}$ , here  $u : U \rightarrow [0,1]$  is a real function. Then the fuzzy number of  $X$  can be written as the following:

$$\mu_U(X) = \sum_{i=1}^n \mu_i(X) I_{A_i}(X)$$

where  $I_{A_i}(x) = 1$ , if  $x \in A_i$ ;  $I_{A_i}(x) = 0$ , if  $x \notin A_i$ ...

If the domain of the universal set is continuous, then the fuzzy number can be written as:

$$\mu_U(X) = \int_{A_i \subseteq A} \mu_i(X) I_{A_i}(X)$$

Note that, in many writings, people used to write a fuzzy number as  $\mu_U(X) = \frac{\mu_1(X)}{A_1} + \frac{\mu_2(X)}{A_2} + \dots + \frac{\mu_n(X)}{A_n}$  (where

"+" stands for "or," and "·" stands for the membership  $\mu_i(X)$  on  $A_i$ ) instead of  $\mu_U(X) = \sum_{i=1}^n \mu_i(X) I_{A_i}(X)$ .

Definition.2. Fuzzy sample mode

Let  $U$  be the universal set (a discussion domain),  $L = \{L_1, L_2, \dots, L_k\}$  be a set of k-linguistic variables on  $U$ , and  $\{FS_i, i = 1, 2, \dots, n\}$  be a sequence of random fuzzy sample on  $U$ . For each sample  $FS_i$ , to assign a linguistic variable  $L_j$  is a normalized membership  $m_{ij} (\sum_{j=1}^k m_{ij} = 1)$ ,

let  $S_j = \sum_{i=1}^n m_{ij}$ ,  $j = 1, 2, \dots, k$ . Then, the maximum value of  $S_j$  (with respect to  $L_j$ ) is called the fuzzy mode (FM) of this sample. That is  $FM = \{L_j \mid S_j = \max_{1 \leq i \leq k} S_i\}$ .

Definition.3. Fuzzy sample mean

Let  $U$  be the universal set (a discussion domain),  $L = \{L_1, L_2, \dots, L_k\}$  be a set of k-linguistic variables on  $U$ , and  $\{FX_i = \frac{m_{i1}}{L_1} + \frac{m_{i2}}{L_2} + \dots + \frac{m_{ik}}{L_k}, i = 1, 2, \dots, n\}$  be a sequence of random fuzzy sample on  $U$ ,  $m_{ij} (\sum_{j=1}^k m_{ij} = 1)$  is the memberships with respect to  $L_j$ . Then, the Fuzzy sample mean is defined as

$$F\bar{X} = \frac{\frac{1}{n} \sum_{i=1}^n m_{i1}}{L_1} + \frac{\frac{1}{n} \sum_{i=1}^n m_{i2}}{L_2} + \dots + \frac{\frac{1}{n} \sum_{i=1}^n m_{ik}}{L_k}$$

B. Fuzzy  $\chi^2$ -test of Homogeneity

Procedures for testing hypothesis of homogeneity of discrete fuzzy samples

- 1) Sample: Let  $\Omega$  be a domain,  $\{L_j, j = 1, \dots, k\}$  be ordered linguistic variables on  $\Omega$ , and  $\{a_1, a_2, \dots, a_m\}$  and  $\{b_1, b_2, \dots, b_n\}$  be random fuzzy sample from population A, B with the standardized membership function  $mA_{ij}, mB_{ij}$ .
- 2) Hypothesis: Two populations A, B have the same distribution ratio. i.e.  $H_0 : F\mu_A = F\mu_B$ ,

where  $F\mu_A = \frac{\frac{1}{m} MA_1}{L_1} + \frac{\frac{1}{m} MA_2}{L_2} + \dots + \frac{\frac{1}{m} MA_k}{L_k}$

$F\mu_B = \frac{\frac{1}{n} MB_1}{L_1} + \frac{\frac{1}{n} MB_2}{L_2} + \dots + \frac{\frac{1}{n} MB_k}{L_k}$ ,

$MA_j = \sum_{i=1}^m mA_{ij}, MB_j = \sum_{i=1}^n mB_{ij}$ .

- 3) Statistics :  $\chi^2 = \sum_{i \in A, B} \sum_{j=1}^c \frac{([Mi_j] - e_{ij})^2}{e_{ij}}$ . (In order to perform the Chi-square test for fuzzy data, we transfer the decimal fractions of  $Mi_j$  in each cell of fuzzy category into the integer  $Mi_j$  by counting 0.5 or higher fractions as 1 and discard the rest.)
- 4) Decision rule: under significance level  $\alpha$ , if  $\chi^2 > \chi^2_{\alpha}(k-1)$ , then we reject  $H_0$  [17]

### III. EMPIRICAL STUDIES

The results of the study include: calculating the memberships of students' options. Each of the six items has five choices, 1 means "strongly disagree", 2 means "disagree", 3 means "no opinion", 4 means "agree", 5 means "strongly agree", and the responders can give scores to each choice. The total score of each item is 1. We also explore the perception of ethnic majority and ethnic minority students.

#### A. Using Fuzzy Mode Analyzes the Perceiving of Relational Bullying of the Teenagers

The responders are junior high school students. There are nine aborigines and twelve new residents. Because of the limited numbers, I divided them into the same group, ethnic minority students. So the participants are sixty four ethnic majority students and twenty one ethnic minority students. They were invited to answer the questionnaire by using fuzzy numbers. It could be a decimal, and the total score of each question is 1. After calculating the fuzzy membership of each item, the result shows at table I.

TABLE I: THE FUZZY MODE OF ETHNIC MAJORITY AND ETHNIC MINORITY STUDENTS' PERCEPTION

item	ethnic	1	2	3	4	5
Teachers have high expectation on me	majority	8.7	8.6	17.2	18.3	11.2
	minority	2.1	2.3	6.1	7.1	3.4
My behavior at school often gets the praise of teachers	majority	4.4	7.5	19.2	19.6	13.4
	minority	1.3	2.9	8.9	6.3	1.6
I get along with classmates	majority	1.1	2.8	9.8	20.3	30.0
	minority	0.5	1.9	3.5	5.9	9.2
I am serious about learning	majority	3.9	7.8	16.8	17.5	26.2
	minority	1.9	2.7	6.6	5.6	4.2
My family in a cordial atmosphere	majority	3.9	5.5	10.4	20.5	23.7
	minority	0.7	1.9	7.5	7.0	3.9
My father (mother) care about my academic performance in school	majority	5.9	3.1	19.3	16.1	19.6
	minority	1.6	2.0	5.9	6.5	5.0

From the above we can see that to ethnic minority students, the highest score of item 1 and item 6 are the dimensions of agree; the highest score of item 2, item 4, and item 5 are the dimension of no opinion; the highest

score of item 3 is the dimension of strongly agree. To ethnic majority, the highest score of item 1 and item 2 are the dimensions of agree; the highest score of item 3, item 4, item 5, and item 6 are the dimensions of strongly agree.

From the result we can find out that ethnic minority and ethnic majority students achieve the same opinions on the agree dimension of item 1 and on the strongly agree dimension of item 3. There are two aspects. One is the two groups of students identify teachers have high expectation on them and their perceptions to teachers' attitude achieve agreement. The other is that the two groups of students identify they can get along with peers well. The two groups have different opinions on item 2, item 4, and item 5. To the three items, most ethnic minority students' perceptions are no opinion, but most ethnic majority students' perceptions are agree or strongly agree. It means that ethnic majority students have better perception on teachers, learning attitude of themselves, and family climate than ethnic minority students. On item 6, the two groups of students almost have the same perception, but ethnic majority students' perception is also better than ethnic minority students.

#### B. Analyzing the Whole Sampling

After statistical analysis, the fuzzy mean shows at table II. The fuzzy expected value is fuzzy number.

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TABLE II: THE FUZZY EXPECTED VALUE OF ETHNIC MAJORITY AND ETHNIC MINORITY STUDENTS' PERCEPTION

item	ethnic	1	2	3	4	5
Teachers have high expectation on me	majority	0.14	0.13	0.27	0.29	0.18
	minority	0.10	0.11	0.29	0.34	0.16
My behavior at school often gets the praise of teachers	majority	0.07	0.12	0.30	0.31	0.21
	minority	0.06	0.14	0.42	0.30	0.08
I get along with classmates	majority	0.02	0.04	0.15	0.32	0.47
	minority	0.03	0.09	0.17	0.28	0.44
I am serious about learning	majority	0.06	0.12	0.26	0.27	0.41
	minority	0.09	0.13	0.31	0.27	0.20
My family in a cordial atmosphere	majority	0.06	0.09	0.16	0.32	0.37
	minority	0.03	0.09	0.36	0.36	0.19
My father (mother) care about my academic performance in school	majority	0.09	0.05	0.30	0.25	0.31
	minority	0.08	0.10	0.28	0.31	0.24

From the above we can see that the highest mean on all dimensions of the 6 items was strongly agree of item 1, and both the two groups have the same perception. It means that both of them have good relationship with peers, and most of them feel that they are accepted by their classmates. To ethnic minority students, the second and the third highest rankings of the expected values are no opinion of item 2 and item 5. To ethnic majority students, the second and the third highest rankings of the expected values are strongly agree of item 4 and item 5. We can see that ethnic majority students hold more positive and conformed attitude to these items than ethnic minority students.

### C. Fuzzy $\chi^2$ -test of homogeneity

To test the perception between different ethnic students, table III is the result of the chi-square test.

TABLE III: THE  $\chi^2$ -TEST BETWEEN ETHNIC MAJORITY AND ETHNIC MINORITY STUDENTS' PERCEPTION

item 1	strongly disagree	disagree	no opinion	agree	strongly agree
the ranking	2816	2809	2736	2711	2815
p value	0.424	0.517	0.867	0.670	0.486
item 2	strongly disagree	disagree	no opinion	agree	strongly agree
the ranking	2806	2689	2606	2772	2995**
p value	0.473	0.488	0.131	0.831	0.006
item 3	strongly disagree	disagree	no opinion	agree	strongly agree
the ranking	2718	2631	2749	2792	2783
p value	0.516	0.084	0.973	0.674	0.748
item 4	strongly disagree	disagree	no opinion	agree	strongly agree
the ranking	2724	2724	2695	2753	2895
p value	0.695	0.753	0.547	0.987	0.121
item 5	strongly disagree	disagree	no opinion	agree	strongly agree
the ranking	2773	2699	2541*	2752	2924
p value	0.702	0.463	0.022	0.996	0.060
item 6	strongly disagree	disagree	no opinion	agree	strongly agree
the ranking	2704	2672	2738	2672	2812
p value	0.466	0.256	0.881	0.401	0.506

\* $p < .05$ . \*\* $p < .01$ .

From the result of homogeneity test, there are significant differences on strongly agree dimension of item 2 and no opinion dimension of item 5. On strongly agree dimension of item 2, the scores of ethnic majority students are significant higher than ethnic minority students. It means that to students' perception on teachers' compliments, ethnic majority students get more than ethnic minority students. On no opinion dimension of item 5, the scores of ethnic minority students are significant higher than ethnic majority students. It means that to the family atmosphere, most ethnic minority students express that they don't have any opinion on it, but ethnic majority students express it more firmly.

## IV. CONCLUSION AND SUGGESTIONS

### A. Conclusion

From the result of the research, we can see that ethnic minority keep conservative attitude toward the questions except item 3. It means that they believed they can get along well with peers, and they don't have difficulty to be with their classmates. But most ethnic majority students agree or strongly agree to the six items. It means that most of them have more positive attitude and have more confidence than ethnic minority students. From the test of homogeneity, we can see that the two groups to most dimensions of the six questions have the same opinions, except strongly agree of item 2 and no opinion of item 5. It means their opinions to the six items are almost the same, and there are little differences between them.

Most people in Taiwan can contain other people. According to my observation I can tell that many ethnic minority students don't care about their identity. When I

asked in class who are the aborigines or the new residents, they raised their hands. Their looking was easy and free, and their classmates also had the same looking. I can feel that they were not afraid of being known as ethnic minority students, and they took it as usual. It meant that they identify to the learning environment and they build good relationship with classmates.

There are more and more inter-ethnic contact, so ethnic boundaries have become unobvious. Many aborigines have moved to urban or rural area to live with ethnic majorities. As time goes by, their lifestyles and habits have no differences with the people of ethnic majority. Although the new residents was born by foreign brides, but most of them grow up in Taiwan. The government of Taiwan encourages the foreign brides to learn various talents to enhance their level of education. It also enhances their quality of family and educational level of their children. Therefore, the results of this study can broadly reflect the actual situation in Taiwan.

### B. Suggestions

According the research above, there are some suggestions as follows.

#### 1) To teachers:

Teachers should be fair in rating. They should not judge students by their different ethnic backgrounds but their actual performance.

Teachers should not hesitate to praise students' performance. By doing so, students feel that they are respected and affirmed. And then they might improve their learning interesting.

#### 2) To parents:

Parents should be more concerned about their children's academic performance and learning situation in school, and it will help improve their performance in many aspects of school.

For the sake of their children, parents should try to create harmonious family. Make their children feel the warmth of a family, and have supported power in their heart.

#### 3) To students:

Friendship is important to junior high school students. Students should hold the attitude of acceptance to different ethnics. They can try to contact and communicate with each other. They can improve their relationship and understand the similarities and differences between different cultures.

Attitude can determine the size of achievement of the future. Students should develop serious attitude to work and then they will become a useful person in the future.

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