EVALUATION ON A DESCRIPTIVE STATISTICS CURRICULUM UNIT IN THE HIGH SCHOOL MATHEMATICS CURRICULUM

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A descriptive statistics unit is integrated in the contemporary high school mathematics curriculum in Taiwan. College teachers, high school mathematics teachers, and students were asked to make comments and reactions. High school students were given a test to understand their learning difficulties. Generally speaking, the college teachers and the high school teachers had a positive evaluation on the curriculum and teaching materials. However, the high school students had a negative reaction. The principal reasons were the unclearness of some statistical concepts and some sections in the textbook and its dull content. Despite this, the students thought that their achievement was good because most content is easy. The students' mean score of the test was also satisfactory. Using a calculator for calculations was not encouraged. The concept of statistical index and the complicated computations or formulae were the difficulties of learning. Therefore, their learning interest was low. The college teachers and the high school mathematics teachers generally thought that descriptive statistics is important, necessary, and appropriate for the high school students. But the high school students did not agree.

PURPOSE AND RESEARCH QUESTIONS

This study was to evaluate the descriptive statistics chapter in Volume 4 of the contemporary mathematics course for the high school in Taiwan. The purpose was to explore the following research questions:

1. How effective is the descriptive statistics curriculum unit in the contemporary mathematics curriculum for the high school?

2. What are students' problems and difficulties in learning descriptive statistics and what are the major factors that may affect students' learning descriptive statistics?

3. What are the problems and difficulties in teaching descriptive statistics and what are the major factors that may affect the instruction on descriptive statistics?

4. How important, necessary, and appropriate is the descriptive statistics unit in the mathematics curriculum for students at high school level in terms of the opinions of the college experts, the high school mathematics teachers, and the students?

MOTIVATIONS AND RATIONALES

In the history of mathematics education, many experts suggested that descriptive statistics be taught at the high school level. The Commission on Mathematics of the College Entrance Examination Board (CEEB, 1959) and the Cambridge Conference (1963) suggested that some statistical content be taught in school. The National Advisory Committee on Mathematics Education (NACOME, 1975) stressed "statistics as an interdisciplinary subject with applications in the natural, physical and social sciences and the humanities" (p. 47). The National Council of Teachers of Mathematics (NCTM, 1980) strongly recommended that statistical skills be included in school mathematics curricula of the 1980s (pp. 3, 7). In 1986, the Board of Directors of the NCTM established the Commission on Standards for School Mathematics to help improve the quality of school mathematics. Three years later, the Commission produced a report on the Curriculum and Evaluation Standard for School Mathematics (NCTM, 1989). Statistics was identified as one of the standards in the mathematics curricula at any school level. In addition, the Commission emphasized the importance of evaluation for the development of curriculum.

In Taiwan, the High School Mathematics Curriculum Compiling Group in the Science Education Center of National Taiwan Normal University (SEC OF NTNU, 1980-1982 and 1984-1986) advocated a descriptive statistics unit be integrated into the high school mathematics curriculum. Because that was a new content, the author wanted to investigate its impacts on the mathematics teaching and learning in the high school. Lue (1985) prepared a descriptive statistics curriculum unit (pp. 316-337 and Lue, 1986) and did a research study about the appropriateness and effectiveness of the unit for Grade 11 students in the junior college of commerce. Although the content of the unit was not totally the same as that of the descriptive statistics unit in the recent mathematics curriculum for the high school, many topics of the two units were the same. He found that the unit was appropriate and effective for Grade 11 students in the junior college of commerce. It is meaningful to see whether a descriptive statistics curriculum unit is also appropriate and effective for high school students.

PROCEDURES AND METHODS

The investigation period began from 1990 to 1992 and was divided into three

stages. The first stage was investigation planning. It began from January of 1990 to July of 1991. Interviews and discussions were the major methods to get data. There were 3 college teachers, 19 mathematics teachers in six high schools, 30 students in seven colleges, and 122 students in three high schools who were interviewed. According to their responses, the questionnaires were designed. There were five aspects in the questionnaire as follows: (1) evaluations on the teaching materials, (2) evaluations on the students' learning, (3) evaluations on the teachers' instruction, (4) evaluating the curriculum and the materials as a whole, and (5) comments on the general questions. On the other hand, the researcher prepared a set of test questions and sent it to college teachers and high school mathematics teachers to ask for evaluation and comment. Two college teachers and 17 high school mathematics teachers presented their comments on the test items. The second stage was the pilot study. It began from August of 1991 to May of 1992. 17 teachers in 8 colleges, 28 mathematics teachers and 82 students in 5 high schools gave back the questionnaires. One class of 54 students in one of the 5 high schools was selected to take the test. After the pilot study, the questionnaires were revised a little bit.

The third stage was the main study. It began from June to October of 1992. The high schools in the Taipei area were divided into three parts. The first part consisted of 5 public schools of which students' scores of the entrance examination were generally better than those in the second part that contained 8 public schools. The third part consisted of 28 private schools. Two schools were randomly selected from each part to participate the main study. In each of the 6 high schools, as many mathematics teachers as possible were asked to respond to the questionnaire. One Grade 11 class was randomly selected to respond to the questionnaire and one Grade 11 class was randomly selected to take the test. In all, there were 56 teachers and 301 students who responded to the questionnaires and 268 students who took the test. On the other hand, 32 college experts in the Taipei area reacted to the general questions about the importance, necessity, and appropriateness of a descriptive statistics unit integrated in the mathematics curriculum at high school level.

DATA ANALYSIS AND CONCLUSIONS

There are multi-choice items and open questions in the questionnaire. Generally, there are five options in the multi-choice items and the options are in order.

The frequency distribution of the questionnaire respondents reacting to each item had been made. The five options were given 1 to 5 points respectively to calculate the average point for each item to understand the inclination of the respondents' reactions to each question. To some questions, χ^2-testing was used to understand whether the reactions were related to different groups (college teachers, high school mathematics teachers, and high school students). The reactions to each open question were also analyzed. As to the test, the frequency distribution of the students who gave the correct answer to each question had been made to find out the learning difficulties. Students' scores on the test in each class were represented in a stem-and-leaf plot with their means and standard deviations. Conclusions and findings are as follows:

EVALUATIONS ON THE CURRICULUM AND TEACHING MATERIALS

Generally speaking, the college teachers and the high school mathematics teachers made a positive evaluation on the curriculum and teaching materials. They thought that it is a good unit. However, the high school students' viewpoints were negative. The students thought that the unit with materials was poor.

In the pilot study, it is found that the evaluations on the whole curriculum were related with the three groups (college experts, high school mathematics teachers, and high school students) by using χ^2-test. The students' evaluations were significantly inclined to be negative. In the main study, we find that there was no significance between the evaluations of the teacher group and the student group. The overall evaluations of the two groups were average.

About admitting a descriptive statistics curriculum unit in the high school mathematics curriculum, the college experts and the high school teachers were inclined to agree. However, the high school students disagreed.

EVALUATIONS ON THE STUDENTS' LEARNING:

This part was to explore the level of learning difficulty, the level of learning interest, and the estimated or self-evaluated achievement. The factors that might affect the students' learning descriptive statistics were also explored.

Most respondents thought that the difficulty level for the students to learn the chapter was median. The high school mathematics teachers and students pointed out that the complicated calculation is the principal difficulty. Some students pointed out

that several sections, such as the sections on sampling, correlation coefficient, and the explanation of standard deviation, were not clear enough.

Although the high school mathematics teacher and the high school students thought that the students' interest in learning the chapter was below average, the students' academic achievement in descriptive statistics was considered to be good.

There were three major factors that might affect the high school students' learning descriptive statistics: (a) no using a calculator causing the calculations complicated and difficult, (b) the teaching materials being dull, and (c) some content being insufficiently detailed.

EVALUATIONS ON THE TEACHERS' INSTRUCTION:

This part was to explore the difficulties of instruction, the level of interest in instruction, and the effect of teaching on students' learning. The factors that might affect instruction were investigated.

Most high school mathematics teachers and most high school students thought that there was no much difficulty in instruction. Although about one third of the teachers thought that they learned little statistical knowledge before and could not teach statistics deeply, many students thought that their mathematics teachers had sufficient knowledge in statistics to teach them. Few students thought that their teachers' statistical knowledge was insufficient. The teachers' interest level in teaching statistics was regarded to be a little above average. Students thought that the effect of the teacher's instruction on their learning descriptive statistics was common. However, they were satisfied with their teacher's instruction. Most students thought that their teacher was enthusiastic in teaching. Students pointed out three principal defects in instruction: (a) using a calculator being not encouraged, (b) being not lifelike, and (c) only following the textbook to teach and lacking new idea.

The teacher's manual was not widely used. Most teachers read a little or little content of the manual. The school teachers also mentioned four major factors that might affect the instruction in descriptive statistics: (a) technical difficulties, such as items needing complicated computations, making some statistical questions disappear in the test, (b) learning little knowledge in statistics making the instruction being not deep, (c) the teaching materials being not good enough, and (d) the students' interest being low. Most college experts emphasized that the trend of the college entrance

examination might affect the school teachers instruction on descriptive statistics.

COMMENTS ON THE GENERAL QUESTIONS

Generally speaking, the two teacher groups thought that the descriptive statistics unit is important, necessary, and appropriate for the high school students. However, the student group was inclined to have a negative opinion. In the pilot study, the viewpoints of the three groups on the importance, the necessity, and the appropriateness of a descriptive statistics curriculum unit for the high school students were significantly different. In the main study, the viewpoints between the college teachers or the high school mathematics teachers and students were significantly different. The teachers' opinion was inclined to be positive and the students' opinion was inclined to be negative.

SUGGESTIONS

The writing of the descriptive statistics chapter has to be refined. The section on sampling has to be condensed. Some statistical concepts, such as standard deviation and correlation coefficient, need to be interpreted more clearly. The students' learning interest in descriptive statistics was not high. The stem-and-leaf plot and the boxplot are interesting statistical content. The author suggested that they be integrated in the chapter. Several intriguing statistical topics, such as statistical anecdotes, statistical expressions related to daily life, and cartoons and dialogues, had better be included in the teaching material to enhance interest. In addition, the calculator ought to be recommended for statistical computations, even in testing. On the other hand, the teacher's manual is supposed to contain enough statistical activities and examples for teachers to use in the class. The teachers are supposed to be encouraged to read the manual before instruction. Moreover, the statistics course should be provided for either pre-service or in-service teacher education.