

Analysis of Achievement Tests in Secondary Chemistry and Biology

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Abstract. The study analyzes the performances of students in a regular high school, a special education school and a special science high school of different regions in the division achievement tests in Chemistry for school year 2009-2010. It also identifies the content of the division achievement tests in chemistry as well as in biology. The biology achievement test serves as a benchmark on how sophomores are being prepared, prior to taking a chemistry course. Test items in the division achievement tests are classified according to the level of thinking being developed. Difficulty indices for each item in the Chemistry achievement tests are also determined. The study found out that both Chemistry and Biology achievement tests focus on factual knowledge which promotes lower order thinking skills. It also found out that the special school and regular high school's performances in the achievement test still fit a bell-shaped normal curve while a special science high school has a skewed to the right curve. Performances of students are also affected by face validity.

Keywords: achievement test in chemistry; achievement test in biology

Background of the Study

Teachers use different assessment tools in assessing their students. One of the assessment tools that teachers use is the achievement test. Tatum (2010) defined achievement tests as examinations that are designed to determine the degree of knowledge and proficiency exhibited by an individual in a specific area or set of areas. In the Philippines, the achievement test is given towards the end of the school year. This is usually given in February or March when all the expected learning competencies given by the Department of Education have been tackled already.

Achievement tests in the public schools are usually provided by the Department of Education, at both division and national levels. The National Educational Testing and Research Center of the Department of Education is the office in charge of administering the achievement test. In the Division of City Schools in Quezon City, the division achievement is made by master teachers in the field and by the Division Supervisor of the area (Division of City Schools – Quezon City, 2010). These reasons have prompted the researchers to conduct a study regarding division achievement tests in different regions.

This study aims to determine and analyze the performances of students in a regular high school, a special school and a special science high school of different regions in the division achievement tests in Chemistry for school year 2009-2010. Moreover, it also identifies the content of the division achievement tests in Chemistry. It also attempts to compare the content of the division achievement test in Biology on how teachers in the second year level prepare students for the Chemistry course that they will be taking after Biology. After the analysis, the study also aims to propose a plan of action in increasing the performance of students in division achievement tests.

Methodology

The researchers gathered Chemistry division achievement tests of different regions where they are teaching. These regions include the National Capital Region (represented by Makati and Quezon City) and Region IV-A (represented by Rizal). One of the researchers teaches Biology and was able to gather a Biology division achievement test in Region V (represented by Albay).

In National Capital Region and Region IV-A, the researchers were able to gather actual data of students' responses on the said Chemistry division achievement tests while in Region V, the researchers were not able to gather actual student responses. The researchers would only use the Biology division achievement test to test the level of thinking that it is promoting in relation to preparing the students to a Chemistry course.

After gathering the needed data, the researchers made an item analysis (see appendices) wherein each question in the division achievement test was categorized into three. These are factual knowledge; conceptual understanding; and reasoning and analysis. After classifying each item, the researchers counted the number of students who were able to give a correct response. From this, they computed for the index of difficulty of each item by dividing the total number of students who were able to give a correct response by the total number of examinees. From the item analysis, the researchers made a table summarizing the levels of thinking and a table summarizing the difficulty index.

Results and Discussion

The following data were collected from the item analysis done.

Table 1. Summary of Level of Thinking

Thinking Levels	Number of Items (Percentage) per Region			
	NCR		IV-A	V
	Quezon City	Makati City		
Factual Knowledge	16 (32%)	18 (36%)	22 (37%)	31 (62%)
Conceptual Understanding	19 (38%)	15 (30%)	21 (35%)	11 (22%)
Reasoning and Analysis	15 (30%)	17 (34%)	17 (28%)	8 (16%)
Total Number of Items	50	50	60	50

Table 1 shows the summary of levels of thinking in the division achievement tests in Chemistry in Regions IV-A and the National Capital Region. It also shows the summary of level of thinking in the division achievement in Biology for region V.

From the table, it is noticeable that in general, division achievement tests give much emphasis on factual knowledge, thereby focusing only on lower order thinking skills. The skills being developed under this category are recalling or recognizing, defining, describing, and using tools and procedures (Mullis, et. al., 2003). The next skill that is given emphasis is conceptual understanding which focuses on illustrating with examples, comparing or contrasting or classifying, representing or modeling, relating, extracting or applying information, finding solutions and explaining (Mullis, et. al., 2003).

The thinking level that is given least emphasis is reasoning and analysis which develop the higher order thinking skills of students like analyzing, interpreting or

solving problems, integrating or synthesizing, hypothesizing or predicting data, drawing conclusions, generalizing, evaluating and justifying (Mullis, et. al., 2003). One will also notice that the Biology division achievement test (as shown by Region V) is similar with the Chemistry division achievement test (as shown by NCR and Region IV-A) in terms of thinking level content. Both give much emphasis on factual knowledge and less on reasoning and analysis.

It is also very evident that the Biology achievement test gives a very big emphasis on factual knowledge having more than 50% of the test items. The 1986 Constitution of the Republic of the Philippines mandates all schools to “encourage critical and creative thinking” (Constitution of the Republic of the Philippines, 2005, p. 55) among all Filipino students. Moreover, the 2002 Basic Education Curriculum prescribes the use of inquiry in teaching science to promote higher order thinking skills, such as critical and creative thinking (Department of Education, 2002).

Table 2. Summary of Difficulty Index

Difficulty Index Range	Number of Items (Percentage) per Region		
	NCR		IV-A
	Quezon City	Makati City	
0.00 – 0.04	4 (8%)	2 (4%)	1 (2%)
0.05 – 0.09	0	0	2 (3%)
0.10 – 0.14	0	2 (4%)	0
0.15 – 0.19	9 (18%)	0	1 (2%)
0.20 – 0.24	0	0	3 (5%)
0.25 – 0.29	0	1 (2%)	2 (3%)
0.30 – 0.34	13 (26%)	0	2 (3%)
0.35 – 0.39	0	0	5 (8%)
0.40 – 0.44	0	1 (2%)	6 (10%)
0.45 – 0.49	0	0	6 (10%)

0.50 – 0.54	7 (14%)	1 (2%)	6 (10%)
0.55 – 0.59	0	0	5 (8%)
0.60 – 0.64	0	1 (2%)	3 (5%)
0.65 – 0.69	7 (14%)	2 (4%)	3 (5%)
0.70 – 0.74	0	2 (4%)	5 (8%)
0.75 – 0.79	0	1 (2%)	2 (4%)
0.80 – 0.84	7 (14%)	1 (2%)	4 (8%)
0.85 – 0.89	0	5 (10%)	2 (3%)
0.90 – 0.94	0	8 (16%)	2 (3%)
0.95 – 0.99	0	6 (12%)	0
1.00	3 (6%)	17 (34%)	0

Table 2 shows the summary of index of difficulty across two regions.

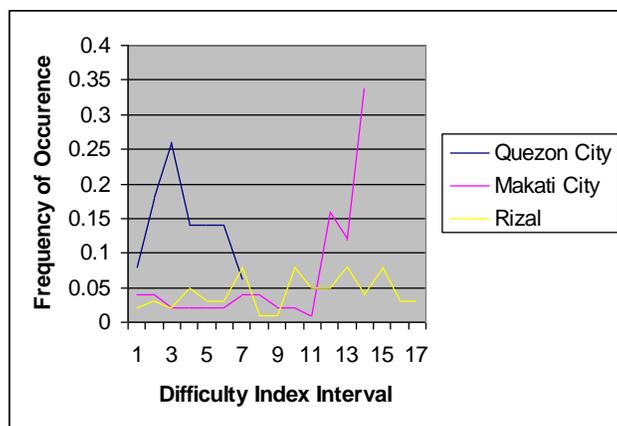


Figure 1.
Difficulty Index Across Regions

You will notice that if you graph (see figure 1) the index of difficulty for Quezon City (NCR) and Region IV-A, you will be able to get a bell-shaped normal curve,

meaning, the scores are equally distributed. The representative school from Quezon City (NCR) is a special school while the representative school from Region IV-A is a regular high school. But if you will graph the index of difficulty for Makati City (NCR), you will not be able to get a bell-shaped normal curve since the scores are not equally distributed. The curve will be skewed to the right, meaning, more students were able to get a correct response to each item in the achievement test. This is because the representative school from Makati City (NCR) is a special science high school.

The items manifesting a very high difficulty index show that the each item is easy and that it needs to be replaced or restructured. On the other hand, the items manifesting a very low difficulty index indicate that the said item is difficult and that it needs to be replaced or restructured, as well. A rough "rule-of-thumb" is that if the item difficulty is more than .75, it is an easy item; if the difficulty is below .25, it is a difficult item (Classroom Assessment, 2010). In other cases, a very low difficulty index would mean that the topic was not tackled in the class.

The result shows that even if it is the government's primary battle cry to produce Filipino citizens with higher order thinking skills, the present classroom instruction proves to be unsuccessful in developing higher order thinking skills among Filipino students. Florencio Abad, the then- secretary of the Department of Education, mentioned that the mastery levels in Science, Mathematics and English are devastating (Abad, 2005, p.8). Abad is referring to the performance of Filipino high school students in various competency- based examinations in 2004.

The bad performance of the Philippines in the Trends in International Mathematics and Science Study (TIMSS) in 2003, ranking near the bottom also shows that Filipino students are weak in terms of higher order thinking abilities because the test required more skills in reasoning and analysis rather than conceptual understanding and factual knowledge (Martin, et. al., 2004).

Table 3. Inconsistencies in the 2009-2010 Division Achievement Tests in Chemistry

Category	Item Numbers by Regions (Total Items =Percentage)		
	NCR		IV-A
	Quezon City	Makati City	
Improper arrangement of choices	6, 9, 11, 14, 15, 16, 22, 23, 25, 27, 35, 37, 40, 42, 46 (15=30%)	0	0
Improper positioning of	0	0	13 (1=2%)

a figure in a test question			
Incomplete question	2, 3, 10, 11, 12, 13, 30 (7=14%)	6, 12 (4%)	21, 30, 41, 43, 52 (5=8%)
Misleading question	35, 45, 48 (6%)	35, 45, 48 (6%)	56 (1=2%)
Misleading choices	0	0	6, 45, 53 (3=5%)
Parallelism in construction of choices	49 (2%)	2 (1=2%)	6 (1=2%)
Typographical Error	5, 23, 38, 46 (4=8%)	2, 3, 11, 9, 30, 32, 37, 45, 46 (18%)	6, 30, 41, 54, 52 (8%)
Unclear figure	0	0	13 (1=2%)

Another factor affecting student achievement in the division achievement test in Chemistry is the face validity of the test itself. Face validity is concerned with how a measure or procedure appears (Colorado State University, 2010). Table Three shows inconsistencies in the 2009-2010 division achievement tests in chemistry. These could be factors that affect the scores of students who took the achievement tests.

Conclusion and Recommendations

As seen in the summary table for levels of thinking, division achievement tests in Chemistry and Biology give much emphasis on factual knowledge, which focuses on developing lower order thinking skills only. The least given emphasis is reasoning and analysis, which focuses on higher order thinking skills. As a result, Filipino high schools students manifested a poor performance in international competency- based examinations, as well as in division and national achievement tests. There are test items that are not face validated and content validated. This also affects the performance of the students in the division achievement tests. Results of the Chemistry achievement test vary from one type of school to another. The special science high school's performance is far better than both the special school and regular high school. Against that, the graphs of the difficulty index for the special school and regular high school are bell-shaped normal curve, meaning, the scores are still equally distributed. To improve the performance of Filipino high school students in international competency- based examinations, the following are recommended:

- a. Test items in the division and national achievement tests should be face and content validated;
- b. The number of test items in the division and national achievement tests for reasoning and analysis should be augmented;
- c. Classroom instruction should encourage creative and critical thinking; and
- d. Teachers should be trained in using classroom instruction that encourages creative and critical thinking.

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