

# The Item Patterns and Students' Response in High-School Achievement Test of Chemistry

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## Abstract

This study investigated the item patterns and students' responses to achievement test items in chemistry that were constructed by a group of chemistry professors under the guidelines of 2010 curriculum outline. This study was funded by College Entrance Examination Center (CEEC) to understand the students' performance of achievement test for entering universities. The items of this test have been divided by those professors into different patterns, including conceptual understanding, algorithmic problem solving, graphic understanding and higher-order cognitive skills (HOCS). This test was administrated to 1115 12th grade students in 7 senior high schools. According to two types of statistics analyses, principal component analysis and cluster analysis, the researchers have found that there were at least three types of items, namely conceptual understanding, graphic understanding, and high-order cognitive skills. Besides that, the researchers have also found the alternative conceptions of nomenclature of functional group in organic compounds. Furthermore, some students used recalling strategy to answer those questions that need analysis and application of oxidation-reduction theory into unfamiliar situations. In sum, this study highlights the functions and importance of different item patterns in high-school achievement test in chemistry. More importantly, this study suggests that the use of graphic representations to investigate students' competence in reading and interpreting relations among different variables and to cultivate students' high-order thinking competence should receive enough attention from policy makers, school teachers, and assessment designers. We hope the results of this study could provide valuable reference for instruction and assessment in high school chemistry, and use them as reference for item designs for large scale entrance examination.

**Keyword:** achievement test, conceptual understanding, graphic understanding, higher-order cognitive skills, misconceptions, senior high school chemistry