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# Investigation of the Change of Science Teacher Candidates' Misconceptions of Acids-Bases with respect to Grade Level

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## SYNOPSIS

## INTRODUCTION

For an effective science education, it is very important that basic science concepts are taught as fully and accurately during the instruction. One of the main goals of science education is to eliminate students' difficulties in science learning and understanding (Köseoğlu, Budak & Kavak, 2002). Among natural sciences, chemistry is one of the fields in which students have learning difficulties because it contains many abstract concepts. The main reason for students' chemistry course failure of at different levels is that students' insufficient and lack of conceptual understanding in the basic chemistry concepts and, depending on this, do not understand higher-level information in next levels (Nakhleh, 1992). Therefore, it is very crucial for students to learn conceptually chemistry subjects. In the literature, there is a number of studies of acid-bases on different learning levels (Ross & Munby, 1991; Nakhleh & Krajcik, 1994; Schmidt, 1991). When the studies have been examined, it is understood that they are the ones that aims usually either to identify the current misconceptions of students or to overcome existing ones by using a variety of techniques. However, in literature, no study was known the change of these misconceptions with respect to level by identifying students' misconceptions about acid-base.

## PURPOSE OF THE STUDY

The purpose of this study is to identify science teacher candidates' misconceptions about acid-base and to investigate the change of the misconceptions according to their grade level.

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## METHODOLOGY

In this study, survey method was used. The sample consisted of 138 science teacher training students in Bayburt education faculty, Bayburt University in second semester of 2010 year. In science teacher training program, the first-year general chemistry and general chemistry labs (I-II) (4 hours per week), and in the second year, analytical chemistry and organic chemistry courses (2 hours per week) are taught. In addition, special topics in chemistry course and a variety of laboratory applications are among other courses related to chemistry included in the program. Chemistry courses are taught considering the traditional teacher-centered approach. As data collection tool, a multiple-choice test with 13-items, including the misconception issue of acid-base subjects, was used. The test was administered another group of students at the same level and its reliability coefficient (Cronbach's alpha) was calculated to be 0.59 and the validity of the test has evaluated on expert opinions. One-way analysis of variance was conducted to determine whether there are statistically significant differences according to means of the misconception test scores of the grades. Prior to this analysis, it was checked whether the assumptions of analysis of variance. In addition, investigating all students' responses to the test items, the misconceptions expressions they hold and their percentages were determined.

## FINDINGS

From Analysis of science teachers' concept test scores, it was calculated the mean and standard deviation values. This findings showed that the average test scores at all levels were very low and student teachers received the average scores ranging from 2.91 to 3.61 from a 13-item test, while the overall average was a very low value as 3.26. Skewness and kurtosis values were examined to check the assumption of normality before the analysis of data. This values ranging between -1.0 and +1.0 show that the normality assumption could be accepted. From Levene test results, it can be inferred that variances are homogeneous cross group. Conducted by considering 1-4 grade student teachers' average mean of misconception test scores of students, one-way analysis of variance (ANOVA) revealed that there is no statistically significant difference between the levels at 0.05 level of significance.

## DISCUSSION

In this study, some following new misconceptions were identified: "as a weak acid is diluted, its percentage of ionization is decreases, dilution of weak acid ionization cause no change in its ionization percentage", since the dissociation constant will be reduced by dilution of a weak acid, its percentage of ionization also is reduced, "acid and bases give neutralization reaction only if their concentrations are equal to each other". It was found some misconceptions vary considerably according to grade levels. The misconception "as a weak acid is diluted, since its dissociation constant will be reduced, so the percentage of ionization also decreases" are almost 30% in first, second and third levels. In fourth grade, this proportion raised to 46%. The misconception "pH is a measure of acidity only" is shared in level of 44%, whereas, in the fourth grade this view was founded is in proportion of relatively low (29%). It was observed that the percentage of the misconception "Acids and bases neutralize only if they are in equal concentrations" in third grade in comparison with other levels is quite low (36%). again one of the interesting finding is that the misconception "as a weak acid is diluted, its ionization percentage is reduced," is shared mostly by all levels. Moreover, while first, second and third grades exhibit the misconception " when a weak acid and strong base solution at equal volume and concentrations are mixed, a neutral solution will appear" in lowest rate, fourth grades carry the misconception " the condition to be an acid of a substance is its having H atom in the structure" in the lowest rate. The similar situation is

valid for the misconceptions "concentrated base solution is stronger than diluted one", all substances that include H atom is acid", when a weak acid and strong bases are mixed at equal volume and concentrations, since acid is weak, neutralization will not completely occur" and" wrong microscopic presentation of weak and strong acid". As shown by analysis of variance, there is no a statistically significant difference between classes in terms of misconceptions of acid-base subject. Though these students took intensive chemistry courses in first years, high misconception ratio in upper classes, even it is interesting that increasing rate of some misconceptions, such as "as a weak acid is diluted, because its acidity constant will be reduced, the percentage of ionization also decreases" and " and "acidity increases with increasing pH", increase, as grade increase. In chemistry courses, when considered the traditional teacher-centered teaching are adopted, it can be thought as an indicator of the courses. Like mentioned in the related literature (Bradley & Mosimege, 1998; Üce & Sarıçayır, 2002), factors such as, students' prior knowledge, textbooks, teaching methods, and not introducing subject issue and concepts in chemistry classes in relation to each other are thought to be among the possible causes of these misconceptions.

## RESULTS and RECOMMENDATIONS

In conclusion, the findings of the study performed to determine whether the students' misconceptions about acid-bases show the differences at different levels suggested no significant difference between grade levels and the misconceptions are shared high rates of up to 80% by the student teachers. This imply, despite the lack of students' conceptual understanding, they become successful in the chemistry courses. In order to overcome misconceptions and to provide meaningful learning , it is important teaching the courses in center of misconceptions, determining misconceptions probing students' previous knowledge of topics prior to lessons, using appropriate teaching methods (i.e. conceptual change texts, concept maps) and alternative measurement and assessment methods (for example, structured grid, diagnostic branched tree. It is clear that this study in the acid-base subject, one of the important topics of chemistry curriculum, should be repeated in other topics and levels.

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