V-DIAGRAM APPLICATIONS ON CHOSEN SUBJECTS IN CHEMISTRY EDUCATION

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SYNOPSIS

Introduction

As one of the instruction methods used in science lessons, the laboratory method refers to the comprehension of the basic scientific knowledge by students through experiments that prove this knowledge carried out by the students themselves in laboratories (Çilenti, 1992). As Nakiboglu states in a study (2001), laboratory work in science education has been attached great importance to and the challenge to identify the role of laboratories in science education has attracted the interest of many researchers (Tamir, 1977; Hoffstein and Lunetta, 1982; Hodson, 1990). Laboratory work is effective on discernment, criticism, understanding science, computation skills, and hand abilities and science laboratories enable students to use knowledge, build on a general concept, define a new problem, explain an observation, and take decisions. Therefore, the laboratory is a part and the focus of Science Education. The expected outcome of laboratory work is generally to foster the theoretical knowledge that students obtain in the classroom by proving them with laboratory experiments. They employ the deduction method in doing so. However, related researches have demonstrated that this approach does not provide a significant contribution to student learning in laboratory environments (Nakiboglu and Meric, 2000; Nakiboglu et al. 2001; Hoffstein and Lunetta, 1982).

Vee diagrams are used to understand or help solve a situation being tried to be explained. Vee diagrams as tools of understanding have been developed as a consequence of long term studies carried out to explain the nature and assist students and educators within the context of science. In order to understand the structure of knowledge as well as to investigate the process of knowledge construction, Gowin’s 5-question concept maps are used (Novak, 1998); the questions are: (1) What is the telling question? (2) What are the key concepts? (3) What methods of inquiry are used? (4) What are the major knowledge claims? (5) What are the value claims? Vee diagrams are an educational evaluation tool that ensures transformation of knowledge into established concepts. Vee diagrams help students to feel better as they can see what they are doing in organizing thinking and in carrying out more effective and efficient actions. The diagrams not only help constructing
links between practical knowledge and theoretical knowledge but also provide an opportunity for the student to use the knowledge they already have.

The diagram consists of a focus question, theoretical part and experimental part. The relation constructed between the theoretical part and experimental part reduces the answer to the problem that belongs to knowledge to the student level. These diagrams help students in understanding the nature of knowledge and, as they are designing a research, in making deductions from results thereof and understanding complex cognitive elements.

Friedler and Tamir (1990) identified the forms of incompetence related to laboratory activities and grouped them under the following headings: Lack of fundamental knowledge required for the experiment, inability to relate theoretical knowledge to observations, insufficiency in organizing observations, information gaps and lack of connections between them.

Nakleh (1994) stated that students fail to fully structuralize their knowledge in the laboratory environment, which distracts them from meaningful learning towards rote learning.

As Nakiboglu et al. (2001) state in their study, Vee diagrams are one of the meta-cognitive tools that facilitate learning (Novak, 1990; Novak, 1998; Passmore, 1998). In their study on Vee diagrams, Roth and Roychoudhury (1993) state that practice makes considerable contribution to meaningful learning and constructing knowledge in mind.

Purpose

Based on the above mentioned significance of using Vee diagram applications in laboratories, the answer to the question, “Does using Vee diagrams in selected topics in laboratories contribute to education and instruction as well as meaningful learning?” is explored. In the study, the “concept mapping” and the 16-item scale used to identify “attitudes towards the use of Vee diagrams” developed by Okebukola (1992) and “attitude scale towards chemistry laboratory” developed by researchers were used to seek answers to the following questions:

“What are students’ attitudes towards chemistry laboratories?”
“What are their attitudes towards the utilization of concept maps and Vee diagrams?”
“Does using Vee diagrams contribute to student success?”
“Do the attitudes of students towards chemistry laboratories and towards the utilization of concept maps and Vee diagrams correlate?”
“Is there a relation between their attitudes towards chemistry laboratories, towards the use of Vee diagrams and their success?”

Making students comprehend Vee diagrams, implementing Vee diagram applications for various chemistry experiments done in fundamental chemistry laboratories, providing the necessary tools to eliminate the possible challenges that students may encounter as they are preparing Vee diagrams, and identifying whether Vee diagrams contribute to conceptual teaching are among the objectives of this study.

Method

The experiment model has been used in the study. The study has been implemented through monitoring under researcher supervision in order to identify cause-result relations. Four experiments selected from among fundamental chemistry laboratory topics were implemented in the sampling group using Vee diagrams. In addition, in order to identify the influence of Vee diagrams on “Attitudes towards Chemistry Laboratories” (ATCL) and
“Attitudes towards Concept Mapping and towards the Use of Vee Diagrams”, the scales were applied as pre-test before the activity and as post-test following the activity.

The research is limited to 244 volunteer students studying in Hacettepe University, Faculty of Education, Physics, Biology, and Chemistry Education Departments.

- In the research study, 30 students from among the Physics Education Department first year students, 30 students from among the Chemistry Education Department first and second year students, and 62 students from the Chemistry Education Department first and second year students, which makes a total of 122 students, participated in the activities related to the development of the ATCL scale,
- 84 students participated in the pilot studies carried out to test the applicability of the scales to be used in the study,
- 42 students studied in the first year of Hacettepe University Chemistry Education Department in 2003 – 2004 educational year contributed to the Vee diagram applications in laboratory activities. Student success was measured based on the grades they took for the Vee diagrams they prepared in the laboratory and their end-term marks.

In the collection of data;
- The 13-item “Attitude Scale towards Chemistry Laboratory” developed by the researchers,
- The “Concept Mapping and the Vee Diagram Scale” developed by Okebukoka (1992), on which validity and dependability work was carried out,
- The Vee diagrams prepared by the students,
- And the grades they received from laboratory experiments were utilized.

With the sampling group, the “sublimation, separation techniques, solution preparation, and acid base titrations” experiments were implemented using V diagrams. To this end, Vee diagrams were distributed to students. They were first asked to fill in the conceptual sections where conceptual maps are. After the experiment activities, they were asked to fill in the experiment-related parts.

Experiment-related claims, knowledge claims, and data conversions in the Vee diagrams collected from the students were each examined and graded based on a 100-grade system. The results they obtained after the evaluation of the Vee diagrams and examination marks were used as success grades.

A Likert type, single-factor 13-item attitude scale, of which validity and dependability has been tested, is used in this study. In the pilot study carried out with students, a meaningful relation between attitudes towards chemistry laboratory and the attitudes towards the utilization of Vee diagrams. Under the light of these data, it has been concluded that in case the attitudes of students towards laboratory, Vee diagram activities may comfortably be carried out. This data at hand demonstrates that students are open to new methods.

**Results and Discussion**

The data obtained as a result of the Vee diagram practice carried out with 42 students in the fundamental chemistry laboratory on the selected topics mentioned above can be outlined as follows:

a) When the results are examined, no statistically significant differences were found between the averages of pre-test and post-test of the ATCL scale. While the pre-test average was 54.14, post-test average was found to be 54.31, however, although the increase in averages is for the post-test, this is not a statistically significant result \[ t_{41}= 0.25; p=0.802 \]. However, when the fact that the maximum score that should be obtained
from this scale is 65 is taken into consideration, it can be asserted that the averages obtained both from the pre-test and post-test are not low. Similarly, no statistically significant differences were found between the averages of the attitude scale towards the conceptual map and Vee diagrams. While the pre-test average was 54.09, post-test average was found to be 57.57, however, this is not a statistically significant result [t(41) = -0.41; p=0.682]. Again, the maximum score that should be obtained from this scale is 80 and the score that should be taken when undecided at all statements, the score that should be obtained is 48. The average pre-test and post-test scale scores obtained is greater than 48. This can be interpreted as the majority of the students have positive attitudes towards the conceptual map and the Vee diagram.

b) The fact that the Pearson correlation coefficient between the attitudes scale towards the conceptual map and the Vee diagrams and the post-test results of the ATCL scale is found to be statistically significant (0.356*) means that if the attitudes of the students towards laboratory is high, they will be able to use such sort of techniques. This can be attained by the creation of laboratory conditions and having the students comprehend the importance of these new techniques and disseminating them. That these techniques are ones that contribute to the meaningful learning of students can be underlined to create interest among students to learn new techniques.

c) When the effects of the utilization of Vee diagrams in the laboratory and the attitudes towards chemistry laboratory on the results that the students obtained in the midterm examination done at the end of laboratory activities and on their success level regarding the Vee diagrams, it was found that the two factors have meaningful influences on the success scores of the students. When the results are examined, it is understood that the two factors are a meaningful predictor of success. 14.3% of the total success is explained by these two factors.

The activity carried out did not provide a significant increase in the attitudes of students towards laboratory. The attitudes of students towards laboratory are already quite high. The maximum score that the students can obtain from the attitude scale towards laboratory is 65 and the minimum is 13. The score that the students would get when they are undecided is 39. The averages are around 54 for both pre-test and post-test, which indicates that a change in the attitudes of students that can be described as negative did not take place before and after the application of the Vee diagram. However, the attitudes towards chemistry laboratories and towards the utilization of concept maps and Vee diagrams are found to be quite important predictors of the success that the students achieve. At the end of this study, the students were made aware that laboratory results can be provided with Vee diagram and therefore, laboratory activities are not merely adding things into some other things to obtain new things as stated in laboratory data sheets, and that laboratories are application spaces, where cause-result relationships should be constructed. And above all, the students were introduced to laboratory conditions that ensure that the students think and where they are mentally more active. The students were moved from a traditional laboratory concept to a different laboratory environment, in which they are more active.

The fact that an increase was obtained between the pre-test and post-test results points out that such applications can be made, although the sad increase was not statistically significant. The reason of not obtaining a very high increase might be attributed to the fact that this is quite a new practice and that this is far from being a technique that the students are familiar with. When the fact that the maximum score that should be obtained from this scale is 80, and 48 when they are undecided, is taken into consideration, the requirement to convince the students that this method is very efficient in teaching and meaningful learning comes to the forefront.
Below are some suggestions to teachers and candidate teachers:

- The test method based on awarding and enforcing rote learning (including multiple-choice, true-false, matching, and filling in the blanks) should be abandoned and instruction-based (phased memorizing) problem solving should be given up;
- Evaluation efforts should be incorporated into education programs to mitigate the parting between learning and measurement;
- Evaluation activities should focus on student based efforts such as conceptual maps, Vee diagrams, skills-based performance, and computer based efforts.
- Special preparations should be made to evaluate the students who have special abilities and who are successful in non-verbal methods (such as visual);
- In the evaluation of individuals working in teams or small groups on a task that requires expertise knowledge and cooperation, evaluation methods that are useful when they are used together or complementing each other should be considered.

As a result, with Vee diagrams the students were saved from rote learning and theoretical knowledge has turned to be more meaningful in the minds of students. Although this was their first experience of using the diagrams, the students did not encounter big difficulties as they are preparing them. Although it is a new method, an increase for post-tests of both attitudes towards laboratories and conceptual framework and Vee diagrams has been possible to be achieved.