Abstract- Chemistry is a practical science, so the great part of teaching and learning includes experiments and demonstrations. In this paper lessons on which any kind of demonstration or experiment takes place is called “practical lesson”. Practical part of subject is important for increasing as understanding of subject but also for the motivation for further learning outside the school and for choosing chemistry as a future career. Well organized practicum at class is a basis of success in these challenge. In this paper class organization types are introduced due to teacher’s goal, class size, students’ educational background. These types of lesson are: demonstration, laboratory work and chemical experiment. Also advantages and limitations for each organization type are discussed.

Keywords- Chemistry At School, Reaction Demonstrations, Class Organization Types, Chemical Experiment At School, School Laboratory.

I. INTRODUCTION

In Georgia the problem of teaching and learning chemistry is increasing year by year, problem is obvious by observing the results of graduating tests from schools and also entrance exams in universities¹. In addition less and less students choose chemistry as their future career, which is not only global problem for Georgia, but also tendency for many other countries². As inquiry shows, most students at school think that chemistry is a boring subject with lots or reactions and rules without logic, which should be just memorized to pass overall exams at school. Most of them wish to have more contact with practical part of chemistry rather than theoretical, paper based learning. It’s also significant that a student in the beginning of learning chemistry (from 8th grade in Georgia) has higher motivation and interest to this science which decreases by every year because of lack of practical and demonstrational works at chemistry classes.

Understanding chemistry is impossible without realization of practical experiments. That’s the goal that reaction demonstration at class aims. Practical part is used as for teaching new concepts, but also for repeating already learnt lessons. So it is appreciable to use practice with theory as often as possible for understanding the subject.

Realization of practical part of the subject requests from a teacher high professionalism, understanding of advantages of practical and experimental part of subject together with theoretical paper-based learning, creativity and mastering in modern methods of teaching chemistry.

Of course, performance of reactions at school, requires various technical instruments and compounds, which is still inaccessible for many schools in Georgia, in this situation teachers’ improvisational skills are valuable. In this conditions teachers have to choose materials correctly, or make them themselves.

Aside from these skills it is mandatory that teachers could perform first aid at class in case of injuries and also teach student the meaning of safe techniques in laboratory³-⁴.

II. CLASSIFICATION OF PRACTICAL LESSONS

Later on we will use term “practical lesson” for lessons in which any kind of experiment or demonstration takes place. We can differ three types of practical lessons: demonstration, laboratory work and chemical experiment. Each of them has advantages and limitations, due to them a teacher chooses the kind of lesson which better applies to his/her goals. Also should be mentioned that a teacher can combine organization types during one lesson.

2.1. DEMONSTRATION

Demonstration, or presentation: teacher presents new reaction or a new concept in front of whole class, students are observers⁵. In teaching through demonstration students are set up to potentially conceptualize class material more effectively as shown in a study which specifically focuses on chemistry demonstrations presented by teachers⁶. While demonstration next methodological rules should be applied:

1) Teacher’s introduction is important before reaction or experiment starts. Student has to understand for what purposes experiment is shown, what it can teach, what is new, and how it can help to understand anew topic.

2) While observing new phenomena or compound, teacher should direct students’ attention towards specific aspects, which are important in understanding new issues. Even while observing well planned visual methods students might miss important facts (such as: temperature changes, volume changes, rate of reaction, etc.) So a teacher has to organize not only experiment, but class’ attention too.
3) Periodical explanations: while demonstration very important is a right correlation between visual methods and oral explanations. Amount and meaning of explanations shouldn’t be decreased by over fascination by visual effects.

This type of lesson can be used for introducing new aspects or theories when students don’t have a big experience in it. Demonstration is very useful in classes with a large number of students, when material or/and technical resources are limited, or when we dial with experiments which requires high technique of performance and special safety rules (reactions with acids, explosives, highly exothermic reactions, etc.)

At this lesson a teacher guides students’ attention, explains each step of experiment, motivates students to make hypotheses and if necessary write reaction equations. Students should make notes of experiments, in future this skills will be useful in writing lab reports.

Topics of demonstrational lessons can be: compound classes, reactions between them, indicators, electrolysis, etc.

Advantages of demonstration are: safety of students, less time and resource expenses, easy organization. Limitations: too often use of this type lessons at least decreases motivation and interest of students as they are not active participants in process of learning, and they don’t develop any practical skills of working in lab.

2.2. LABORATORY WORK

Laboratory work includes more interaction of students: in this type of lesson students make experiments with help and instructions of a teacher. They are able to develop practical skills and students are actively learning. But differently from demonstrational lessons, students have to have some educational background about experiment they are planning to do. They should be able to plan some parts of experiment and what’s mandatory, they must perform safety rules.

In this type of lessons teacher is a “guide” which shows directions in the planning and performing experiments. But also teacher has to examine how ready students are for each experiment, what they already know and what they should know to perform experiment correctly and successfully. In progress of lesson teacher gives advice and if necessary interacts in process.

Advantages of laboratory work depend on the principle of “learning from practice” theory. Dewey argued that “if knowledge come from the impressions made upon us by natural objects, it is impossible to procure knowledge without the use of objects which impress the mind.” Students can develop practical skills of planning and performing chemical experiments, motivation of learning chemistry increases and students with more joy participate in lessons.

Limitations: classes with a large number of students demand big amount of resources. Also teacher needs a help of a lab assistant. In situations when resources are limited students can work in pairs or small groups (4-5 members in a group).

2.3 CHEMICAL EXPERIMENT

We can classify two kinds of chemical experiments: scientific and educational experiments. Scientific experiment differs from educational with possibilities of making new researches, examining unknown phenomena or new compound, if necessary make and test a new hypothesis and evaluate the results of the experiment. In other hand educational experiment deals with already know results, conditions are chosen so, that students can observe results which are known from the beginning of experiment.

In case of performing an experiment independently students plan and perform reactions themselves, without teacher’s significant interaction. Steps of the experiment are:

1. make observation
2. Formulate a hypothesis.
3. Design and conduct an experiment to test the hypothesis.
4. evaluate the results of the experiment
5. accept or reject the hypothesis
6. if necessary make and test a new hypothesis.9

Nowadays this type of lessons are less popular at our school, because it requires from students well developed skills, educational background and excess of technical and material resources at school.

In this kind of lessons teacher needs to have a lab assistant to take care and pay attention to all students’ works. Especially, safety rules must be held on high level. Experiments which can be done by an average student at secondary school are limited, but this type of organization can be used for learning separation of solutions e.g. water and sand, iron and sulfur mixture, salt and water, observation of growth of crystals in different conditions etc.

As in case of laboratory works we can organize class in pairs or small groups as well as individual working students.

Differently from demonstrational and laboratory type lessons on experimental works we can give marks to students due to their skills and experiment performance. Also students have to make their lab reports which is essential part of all laboratory courses.
Advantages are: high motivation of students, developing practical skills in working in lab, deeper understanding of chemistry. Experiment can raise test scores and help a student become more engaged and interested in the material they are learning. Limitations occur with number of experiments which is quite small, with classes with a big number of students, time and material resource limitations at schools.

### III. CLASS ORGANISATION TYPES

While laboratory work and chemical experiment it is very important to organize class correctly, which deals with understanding of teacher’s goal, results which are to reach at the end of the lesson, number of students at class and their knowledge in the subject, material resources of school laboratory, time limitation, difficulties of experiment, etc. Three kind of organization we can use:

- work in small groups
- work in pairs
- individual work

For work in groups, it is preferable to create groups with 3-4 students only and distribute work among group mates at the beginning of work. This method allows interaction of more students with less expenses, teaches them team work. On other hand groups with more students are harder to manage, not all student are able to take active part into work, and it is also harder to keep safety rules. Work in pairs can avoid failures of group work: more students are actively participating into learning, and we can use grade system for students, which can be different among the same group depending of student’s role and activity in experiment.

When organizing pairs it is preferable to pair students with almost same knowledge, other ways if students in pair are very different, whole work is performed mostly by the student with higher educational background and the other student stays passive. Individual experiment almost doesn’t takes place at our schools nowadays, because of material and human resources of schools.

### CONCLUSIONS

Teaching and learning chemistry is deeply attached to chemical experiments and laboratory works at school. School chemistry classes motivates students for further learning and choosing chemistry as their future career. So, teacher of chemistry has a big part in growing up future professionals.

The aim of this paper was to analyze some aspects of teaching chemistry at secondary schools, organization of practical lessons, lesson types with their advantages and limitations to reach better results.

### REFERENCES


[3] National Science Teachers Association “Safety in the science classroom, laboratory or field sites”.


