

Laboratory Classes in Chemistry Texts of Secondary Level and Issues of Their Quality Improvement

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Abstract

It is well known that the acquisition of knowledge in natural sciences in school is closely related to the training of practical capabilities of the students. Even chemistry, as a natural science discipline is related to this factor. The 9th year Albanian scholar system, during the teaching process, encounters a wide range of problems of different nature. Their evidention, as well as the difficulties that are met during the training of practical capabilities of the students, is the main goal of this paper. A whole study of the altertexts demonstrates the difficulties encountered by the students during the laboratory classes. The wide variety of chemicals in laboratory works mentioned in different textbooks makes it very necessary the standartization process. Another issue for the authores is if the experiments and the suggenstions presented in each text book are the most representative for each topic. The organization way of laboratory classes/works is another issue to be considered when studing altertexts. Taking in consideration the time of experiment development, the number of the students present in class, as well as the the time to complete the results and discussion for each experiment, this paper propounds some ideas in order to improve this important teaching component. Based on the experience of foreing contries, that the experimental work should not be limited only during the class time, it is suggested that giving experimental taks for homework would serve not only for the enforcement of the practical capabilities of the students, but also for the better assimilation of chemical knowledge. Focusing on specific topics, it is clearly evident that not all the teaching themes can be illustrated experimentally. The impossibility of experimental realization of chemical knowledge, as a consequence of the lack of the materials, makes it necessary the use of better experiences. Using of internet or computer confrontes the implementers with a variety of difficulties which will also be analized in this paper.

Keywords: Chemicals, experiment, teacher, curricula, student, visualization

1. Introduction

The scientific education plays a critical role in the student formation of the 9th year scholar system. Recognition of new teaching ways and methodologies, as well as the objective for a better appropriation of the scientific knowledge gained in these sciences constitutes a constant all-time target. Considering the wide range of natural disciplines which are taught in this school cycle, chemistry has an important role. In the 9th year scholar system it is studied from the 7th grade to the 9th grade, with a total teaching load that varies from 35 hours in the 7th grade to 70 hours in the 9th grade.

Likewise any other natural discipline, and judging from its scientific specifics, nowadays the chemistry teaching can not be thought without its practical laboratory component. Practical education in this discipline is not only related with the better acquisition of the theoretical knowledge, but also with other aspects, that in addition to the practical training of the students, are associated with educating the desire toward other natural science and technical professions, which are underestimated in the current Albanian reality.

The aim of this paper is the evidention of the difficulties on practical training of the students during the teaching process. This aim is accomplish through a detailed analysis of the main teaching characteristics in chemistry at 9th year system. This analysis is accompanied with the evidention of practical issues of this process, focusing in the teaching difficulties by the teachers, as well as in the chemical knowledge assimilation difficulties by the students. The detailed analysis of chemistry texts in use and teaching problems concludes with important suggestions in order to increase the efectivity in the process in the practical capabilities of the students.

2. General Characteristics of Chemistry Teaching

The latest development of society and technology highlight the importance of application technique to any science for the new generations that should be prepared in facing the future challenges. After all, this should be the core of the education in general. Taking in consideration the problem of increasing the level of student knowledge acquisition, it is almost clear that knowledge acquisition in school is closely related with the coordination of all the factors associated with this process. In the light of this reality, the necessity of laboratory practical training takes a first hand importance as it fulfills an obligation. Some of the particularities that characterize this relation in our teaching reality include:

- a. The experimental character of the discipline. As any other natural discipline, chemistry is considered as purely experimental science. As such, the experiment must take its place and its importance in the teaching process. The encouragement of the experimental work clarifies the meaning of theoretical topics and vanishes/disappears the passivity that might be created during a class where everything is connected with the teacher word. When considering the experimental work in the 9th scholar system, it should be kept in mind the massive experiment as well as the demonstrative one. Evolving of the concepts or of the compounds properties through experiment stimulates the desire of the students for this subject. (during an demonstrative experiment in 8th grade chemistry, it was noticed that the acquisition of the new knowledges increased with 17-25%)
- b. Materials and laboratory basis. Considering the experimental character of this science, the chemical experiment cannot be thought without the proper material and laboratory basis, in order to make possible the experimental illustration of the theoretical material through demonstrative experiment, making thus the teaching process more active. The reality in our schools suffers deficiencies in providing the basic materials for the laboratory works. Despite the achievements in recent times, the school reality especially in public schools needs further supplementing. The lack of teaching materials in chemistry classes in many schools, particularly in rural areas, separates this discipline from its experimental character and in many cases makes it very difficult its acquisition.
- c. Altertexts, auxiliary literature and chemistry teaching. It is already known that the reality of today's school textbooks is characterized by text diversity. This diversity should create the competition opportunity that would lead to the quality improvement. The high number of these texts, despite the basic document approved by the Ministry of Education leads to several difficulties related with the provision of necessary materials for practical work, as well as with the selection of the most representative experiments. Moreover, the teacher's auxiliary literature is insufficient for the practical professional and experimental training. In these conditions, the learning professional forums would make possible the exchange of the ideas and opinions in our reality, where the publications in support of schools and chemistry teachers are scarce.
- d. The place of laboratory work in chemistry teaching. Focusing in laboratory work presented in some of chemistry textbooks of our 9th year scholar system, it can be noticed the small number of laboratory hours with practical character in them. For an experimental science, such as chemistry it is difficult to build the normal activity in class based only in theoretical material. Theoretical elements should be a natural product of the conclusions drawn from the experimental practice.

3. The Problems and Difficulties in Chemistry Teaching

Focusing on the features mentioned above, the completion of which would raise the quality of the teaching process, there are a number of difficulties that might become a limiting factor towards the successful implementation of teaching and educational objectives. The recognition of these factors would help not only focusing on them, but also at the same time would minimize the causes that can realistically be considered inevitable during the chemistry teaching. The main difficulties in chemistry teaching are classified as below:

- a. Chemical experiment and the need for unification, the need for recognition and expense calculation. Albania is a small country with large inherited deficiencies regarding the material base in schools. Similarly, the distribution of numerous 9th year schools and in many cases the lack of infrastructure, such as laboratory or appropriate working environments, causes a lot of difficulties. Despite the positive efforts, especially in recent times, it is almost impossible the thorough fulfillment of these needs. In terms of didactic teaching, it can not be thought of chemical teaching without the chemical and practical experiment. The standardization of basic experiments would enable the easier management of each school needs, as well as the fixing costs for developing an optimal laboratory activity based on the number of the students.

- b. Seeking new ways of chemical experiment application in school. Focusing in this component, it can be said that the chemical experiment is conducted as a demonstrative or massive one. Based on the experience of other countries, chemical experiment can be performed in home conditions, where with everyday life means could easily be developed a series of experiments that would facilitate the teachers' work and the realization of understanding in a given topic in class. On the other hand, using the experience of other schools would enable the enrichment with audiovisual materials about the chemical experiment in school. The provision of these materials would help teachers in order to achieve the objectives of a given topic, as well as the students towards a better acquisition of the knowledge for the topic. Through these materials, particular topics, concepts, models, mechanisms, illustrations, as well as experiments for certain issues could be described easily.
- c. Methodology of chemical experiment in school. The effectiveness of practical laboratory classes is very important in chemistry teaching. This includes even the public schools with around 40 students per class and with very scarce laboratory facilities to perform practical topics. In an environment such as the classroom with very limited size, for a period of 45 minutes, the students should perform successfully a certain laboratory work. When carrying out the tasks for each practical work, the student faces several difficulties, such as the teacher control over the class, the explanation of technical safety regulations in the lab, the organization of the lab work, the problems of visualization of the experiment results, and the presentation of the experimental findings in the notebook. Everything should be done in a period of time of 45 minutes. The utilization of the materials over the years, as well as the maintenance of educational materials in our educational institutions, is not only a valuable work in terms of history or teaching process in a given institution, but also a valuable source of effective teaching means.

4. The Interactive Factors in Chemistry Teaching

Teaching, including the chemistry teaching, is a complex process where several factors are combined with each other. It is a process of interaction where the center of gravity is disconnected from the teacher and is displaced towards the students. The analysis of the interacting factors and the connections between them makes it almost impossible the thorough review of the above issues. Avoiding the focus on all the factors that affect the teaching process, it is presented the relationship between the chemical experiment and three basic factors, school curricula, teacher and student.

- a. Curricula. The chemistry curricula represent the content and define the stages of chemistry knowledge acquisition. It is approved by the Ministry of Education and Science, but there are spaces within the curricula framework to act in a more independent way. The textbooks of this discipline are then compiled based on this curricula. The review of some of the textbooks shows the lack of the performance of the most representative experiments in each chapter, as well as of the changes that in most cases are conditioned by tools and materials that are difficult to obtain. Considering the practical skill training or material preparation for the successful laboratory classes, the school curricula offers very few opportunities. Therefore, for this reason we believe that the school textbook should be accompanied by other auxiliary materials, especially for the practical laboratory work. The utilization of other developed countries experiences in curricula compilation, as well as in the successful use of experiment in chemistry would be a positive step in the development of this teaching discipline.
- b. Teacher. The teacher represents an important point in the process of student practical training and in their activation toward experiment performance. The teacher is the "conductor" of the educational process. Focusing on the subject in discussion, there are noticed a number of problems with this figure. Based on the questionnaires conducted with chemistry teachers, a number of difficulties have emerged, some of which are related with objective factors as follows:
 1. *The performance of the experiment by the teacher himself.* A high percentage of the teachers today have completed their university studies in the last 25 years, a period that unfortunately belongs to the problematic Albanian transition with lackages in their scientific formation. In the conditions when even the teachers have deficiencies in their scientific formation, they cannot be convincing in theoretical or experimental treatment of chemistry knowledge. Teacher qualification, as a need of the time, should not be confined only to theoretical elements, especially in sciences with practical and experimental character such as chemistry.
 2. *Massive and demonstrative experiment organisation in class.* For the above mentioned reasons, the

chemistry teacher faces a number of difficulties during the practical work in this discipline. For a massive experiment with the whole class, the teacher should have very clear ideas about it; why this experiment is necessary, will it increase the student interest, is it the bases of the new teaching material or it just illustrates the theoretical material learned ago, is it complicated, is it suitable with the student age and scientific formation, which is the extent of its risk, how many chemicals are consumed during its performance, how much time is devoted to specific components of massive experiment in class.

3. *Selection of the most representative experiments.* Based on interviews with chemistry teachers, it was observed that many of the conducted experiments in class are not related to a particular topic or are not in function of the theoretical material, in some cases because of the lack of the materials. It is the teacher duty that considering the laboratory materials available, to choose the experiment which is related with a certain topic in order to improve the theoretical material acquisition.
 4. *The inability to cover with chemical experiments the main chapters of the discipline.* Considering the experience in terms of student practical training, it is noticed that the web offers a large numbers of experiments that could be practically performed without any particular difficulty. The impossibility of experiment performance directly by students or even by the teacher in different laboratory works makes it necessary the requirement of new ways of practical training and alternative methodical experimental materials, which should increase the teaching effectiveness. The treatment of certain passages in chemical experiments in accordance with the programe and their enrichment over time would provide valuable experimental teaching packages for the students and the teachers. Their preparation at the same time by the institutions that prepare future teachers would be a pleasurable contribution in this regard. The visualization of chemical reactions from the web would be helpful in fully understanding their mechanisms.
 5. *Knowing the expences and finding the most suitable ways.* Considering this topic, none of the teachers met in 25 schools in Elbasan prefecture had any information about the necessary amount of materials and chemicals consumed per student unit, in order to calculate the real costs. When asking "what did they think about providing the necessary materials", all of the teachers complained and had their request regarding this point, but they did not know specifically what to request and how much to request. In the absence of the need funds, the provision of materials from everyday life creates the oppurtunities for a better performance of experiments in the classroom and outside of it.
- c. Student. The student represents the most important part of the teaching process, and therefore his involvement in experiments and practical works would increase the teaching quality. The thorough familiarity is achieved when every student carries out, touches and performs the experiment by himself. A survey was conducted with 562 students and it showed that only 79 of them had performed chemical experiments in school. 327 of them never carried out laboratory works dne 143 did not recognize the erlenmayer. When they were asked "why they did not perform experiments in chemistry", their response was the lack of laboratory materials. To the question "have you ever performed any amusing experiment in school", 502 students were expressed negatively, and the rest of them were confused about the question and gave non clear answers. Taking in consideration the above questionnaire, it can be believed that the focus on the collaboration with teachers for the preparation of functional and entertaining experiments would encourage their commitment for the future and would constitute an incentive of knowledge acquisition or even to make this discipline to be liked by the students.

5. Conclusions and Suggestions

Based on the above analysis, it can be noticed that there should be a close connection between the teacher and the students for a better and active chemistry knowledge acquisition in the 9th year scholar system in accordance with the shool curricula. It is now obvious that the use of laboratory and of the experiment contribute to a better acquisition of scientific knowledge in chemistry as a teaching discipline. But this can never be considered as the only factor for the optimal appropriation of chemical knowledge in school. Other factors, especially the concrete teacher's work, constitute a useful and helpful tool in active knowledge acquisition not only during the teaching process in class, but also outside it. It can be easily understandable that even though there can be many recipes, the compliance with the class conditions and specifics or with a given topic, as well as with many other factors would constitute a powerful "weapon" for an efficient use toward the best acquisition of the scientific knowledge.

Considering the above analysis about the use of chemical experiment in the 9th year scholar system in this discipline teaching, it can be suggested as follows:

1. The curricula revision leaving more space to the chemical experiment in school. Its review creates opportunities to leave more space to chemical experiment. On this basis, the existing textbooks could be revised in accordance with the new curricula. There might be determined the basic experiments, which could be massive or demonstrative ones. This definition would help later each school in the preparation of main materials of the performance of the experimental work. In the light of this review, chemical experiments could be given as home works, so they can be performed with everyday life materials. In addition, auxiliary documents could be prepared in order to give the proper importance to the organization and practical performance of chemical laboratory classes, in fully accordance with the curricula.
2. The establishment of chemistry laboratories where they do not exist and their enrichment with materials and chemicals. Judging by the importance of chemical laboratory in knowledge acquisition, there necessarily should be an intensive work in chemistry laboratory promotion in schools. For this reason, it can be prepared a document type that is related with the main criteria that should be met by school laboratory of a certain level and on the basis of this document later on it should aimed to its completion to achieve a certain standard. There cannot be a high level in school achievements without a high level preparation in natural sciences. There cannot be a high level preparation in natural sciences without the laboratory and without the material base. Moreover, the enrichment of laboratories in general and those of chemistry in particular should be an ongoing obligation.
3. Training during the school time and after it in terms of knowing and using the techniques of chemical experiment in school. The realization of the above tasks requires skilled teachers with a commitment for the profession. Their preparation begins during the school time. Almost all the universities in Albania prepare future teachers. Considering their teaching programs, particularly those related with the teacher professional formation, new disciplines such as "Chemical experiment in school" would contribute in avoiding teaching weakness in today's teachers.
4. The continuous teachers' qualification, with techniques of chemical experiment in school as an important part of it. Supporting this point would make it possible the improvement of teachers' quality and as a consequence the increase of practical student training.
5. The preparation of standard experiments as a help for the schools. Likewise the education is supported by the standards, even in chemistry discipline standard representing experiments should be prepared in order to illustrate or practically explain the theoretical material. Based on preassigned these experiments, there can be prepared auxiliary texts in order to normally perform these laboratory works. This would avoid the difficulties during the changes of the textbooks and would low the costs.
6. The preparation of auxiliary materials for the chemical experiment in school. The education in general needs several auxiliary materials. These materials should not always be expected from the Ministry or its structures. The collection of experiences, their use and their continuous enrichment would lead to a value added to each school. Already in teacher online forums, there can be found endless teaching materials. Their collection and their enrichment is a good investment that can be overestimated over time.

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