

# EFFICIENCY OF POWERPOINT PRESENTATION AS A COMPONENT OF SCIENCE EDUCATION

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## Abstract

*In recent years, information and communication technologies have been used in the educational process, including teaching of natural sciences. It is generally assumed that these tools have positive effect on the motivation and activation of pupils. However, there has not been much research focusing on the effect these new educational means and methods might have on the learning process in pupils, the position of teachers and on the real performance of pupils. For the above mentioned reasons, the research work which is dealt with in this article aims at eliciting the efficiency, advantages and disadvantages of the use of ICT, namely PowerPoint presentations, in different components of educational process in the field of natural sciences. The research focuses not only on the creation of presentations as didactic tools, but also on finding the optimal, most purposeful and most effective way to use presentations in the educational process. The article summarizes results so far yielded by the research which includes several years of work focusing on the production of didactic presentations and on the feed back from teachers and pupils. These efforts allow defining difficulties involved in the use of presentations, offering remedies and testing all the findings in practice.*

**Key words:** *effectiveness of teaching, PowerPoint presentation, questionnaire investigation, science education.*

## Introduction

Presentations of the curriculum created in the programme MS PowerPoint, or in other applications, have recently become a common component of tertiary education and started to appear in secondary school teaching. A method traditionally used at universities is a lecture, which is duly justified. Lecturing enables a transfer of great amount of information to a large audience at the same time. A disadvantage of lecturing mainly consists in low activation, practically zero feedback, and loss of students' attentiveness. These are the aspects where an appropriate use of presentations could be helpful. Teaching at secondary schools is organized in smaller groups of students, which enables us to use a greater number of teaching methods. The use of PowerPoint as a teaching tool therefore offers for secondary schools a wider choice of possibilities.

*Effectiveness of university lectures supplemented with computer presentations of the curriculum*

The impacts of this didactic tool on the educational process were not initially studied at all. First the authors of scientific articles from the educational area only dealt with the rules and

recommendations on how to create a presentation (Holzl, 1997). Later the research appeared which verified the assumption that lectures supplemented with computer presentations of the curriculum were more effective than lectures with the use of blackboard and chalk or overhead projector. This research was based on questionnaire investigation among students, to whom a part of lectures was delivered traditionally while the other part was supplemented with PowerPoint presentations. The results of these investigations show that the students consider the lectures supplemented with presentations as more effective, interesting, and helpful. At the same time the results of tests among these students were compared and here no real increase of effectiveness was observed. (Bartsch, Cobern, 2003; Apperson, 2006; Corbeil, 2007; Susskind, 2008). Some authors explain the difference between the impressions of the students and the proved effectiveness through a halo effect (Susskind, 2008), i.e. the first impression, which is not necessarily a reflection of long-term experience.

#### *Influence of computer presentations of the curriculum on the lecturer*

It can, however, be assumed that a frequent use of computer presentations of the curriculum at universities results mainly from enthusiasm of lecturers to apply the presentations in their lectures. Creation of presentations is a rather pleasant activity; a completed presentation can be easily modified for the use in different types of groups of students and in different years. Further, presentations can serve as a prop for oral performance of the lecturer and thus they can improve the quality of the lecture. There is also the research that studies the role of the lecturer and the influence of presentation on the lecturer's performance (Hardin, 2007). The results proved that perception of teaching on the part of students is markedly influenced by the lecturer and only in small extent by the employed material didactic tool.

#### *Research problem*

It is therefore evident that computer presentations in general do not bring to the teaching process a revolutionary solution of how to encourage the students, how to increase their interest in lectures or how to improve their results in studies. At the same time, computer presentations of the curriculum cannot help a poor lecturer to markedly increase the quality of his/her lectures. Nevertheless the presentations have already found their place in the teaching process. Therefore the questions arise related to the structure, the form, the way of how to use graphics and text within the presentation to reach the highest possible influence required in terms of effectiveness and to reduce, in the most possible extent, the loss of students' attentiveness. The problems that therefore occur are those of how to maintain the students' attentiveness, how, on the contrary, to avoid the loss of their attentiveness due to the use of undesirable elements in presentations, etc. Another question is the difference between the possibilities of the use of presentations at universities and secondary schools, where there are smaller groups of students involved in teaching and where the contact between the teacher and the student is more pronounced. The research, the results of which are the subject of this article, strives to find the answers to the above questions.

### **Methodology of Research**

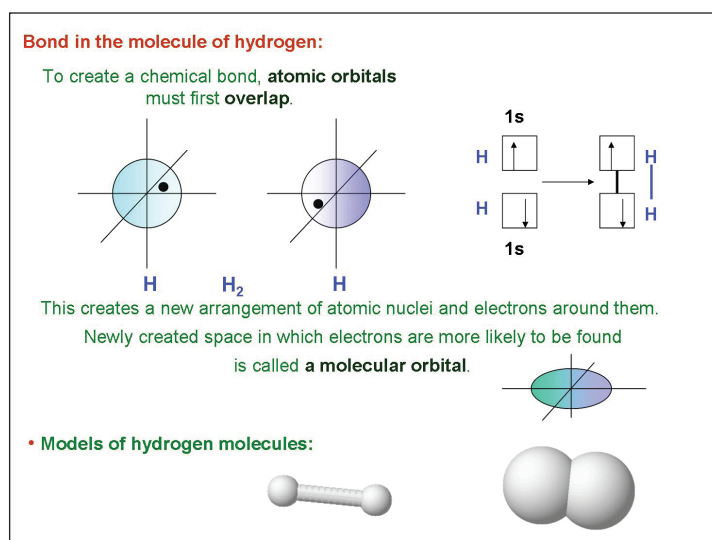
#### *Development of research work*

Biology, Chemistry and Physics are among the most important of Science subjects. Chemistry, as a whole faces the problem of low popularity among the students of secondary schools. Annually, according to popularity surveys, it takes the place among the three less popular subjects. General chemistry is usually taught as introductory curriculum for the subject chemistry, while being very difficult and abstract. At the same time the comprehension of this subject matter is an assumption for a proper mastering of any further curriculum. It can therefore be assumed

that demandingness and low attractiveness of general chemistry importantly contribute to why chemistry as a whole is so unpopular. The consequence of this is also a lesser interest in chemistry studies at universities. Therefore efforts occurred to create, within this research, the presentations whose integral part are illustrative elements (pictures, photos, models, graphs, tables, diagrams, and simple animations), mainly from the area of chemistry (Urbanová, 2007).

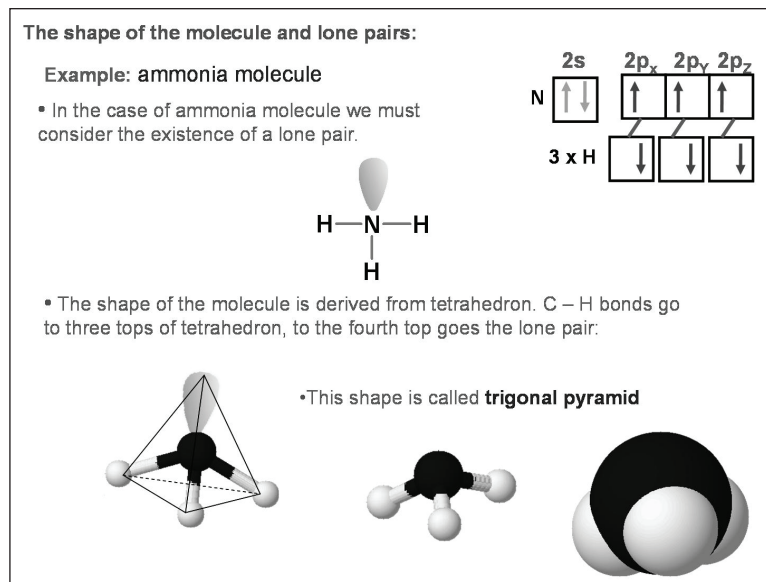
In the first phase of research project, ten presentations were created from the area of general chemistry (see the presentation slides 1 and 2). The use of MS PowerPoint seemed to be an appropriate variant leading to the increase in curriculum comprehension, to the increase in interest in curriculum and thereby to the increase in effectiveness of teaching. These presentations were at first created on the basis of experience with this teaching tool. Another important consideration taken into account was the information acquired from various researches related to both directly PowerPoint presentations, but also to the contributions dealing with the influence of graphics and elements applied in teaching materials on the attentiveness of students and effectiveness of teaching.

### Slide 1. Chemical bond in the molecule of hydrogen.



The example can be the research (Bartsch, Cobern, 2003), which was devoted to the use of pictures in presentations and which attempted to answer the question of what had a greater influence on memorizing the information – whether it was the mere text, the text supplemented with the picture not directly relevant to the topic or the relevant picture. This investigation showed a positive influence of relevant pictures and, on the contrary, deterioration in memorizing the information supplemented with irrelevant pictures. This finding is necessary to take into consideration when using various clipart. Here a common argument is the increase of students' attentiveness due to an unexpected element, etc. However, this research also shows that at the same time these pictures distract the students' attentiveness from the information that the presenter strives to deliver at this very moment. It is therefore necessary to consider the purposefulness of the use of these activation elements in presentations. Another piece of work to mention is Priestly, 1991, where the author discusses the use of various fonts, options for text highlighting, text colouring, the use of lower and upper case letters, etc. This piece of work is based on several researches from typography. The author e.g. supports a positive influence on reader's attentiveness when lower case letters are preferred to upper case letters. The words composed of upper case letters are as a whole viewed by the human eye as a rectangle while the words composed of lower case letters are in their upper half part more broken and therefore bolder for the eye.

**Slide 2. The shape of the molecule and lone pairs.**



In the next phase, the teachers, who were interested in the use of presentations in their lessons, were asked to take part in the seminar where these presentations were introduced and the teachers' questions about the work with presentations in their lessons were answered. Already this phase brought the first information though it was first of all the phase of preparation. A substantial effect was a direct contact with teachers, their reactions and questions. Approximately after a month, the first reactions of teachers based on questionnaires were available.

*Questionnaire investigation*

In this research that was running in the years 2006-2008, the teachers of secondary schools were given 10 PowerPoint presentations of general chemistry curriculum; each of them was designed for one teaching hour lasting 45 minutes. The teachers were introduced to the content and the method of presentation use within four half-day workshops. For each presentation there was a short text devoted to the content and objectives of the presentations and also to the questions and tasks that are an integral part of the presentations. Presentations were created for the method of lecturing supplemented with activation elements in the form of above mentioned questions and tasks. All questions and tasks offered author's solutions included directly in the presentations.

Questionnaire investigation included 20 teachers from 17 secondary schools (15 from Prague and 2 from smaller towns), who assessed the possibilities of the use of presentations in 41 classes with a total of 1107 students (maximum number of students per class was 30).

A submitted questionnaire contained 5 closed items and 7 open items. It was focused on the questions of graphics of the submitted presentations, the system of submitted questions and tasks, and the assessment of effectiveness of teaching supplemented with presentations. In the questionnaire the teachers also expressed their opinions on the effectiveness of work with pre-prepared presentation, e.g. from the point of view of time. Moreover the questionnaire contained one question related to the technical equipment of schools to enable us to relate the acquired information to the technical equipment available in the classrooms where the investigation was carried out.

Closed items served for a faster, measurable assessment of submitted presentations. Open items were designed to map subjective opinions of teachers, who used the presentations in their classroom teaching and outputs of these open items were considered to be the main outcome

of this research. The assessment of questionnaire open items was carried out through a gradual categorization of parts of respondents' questions.

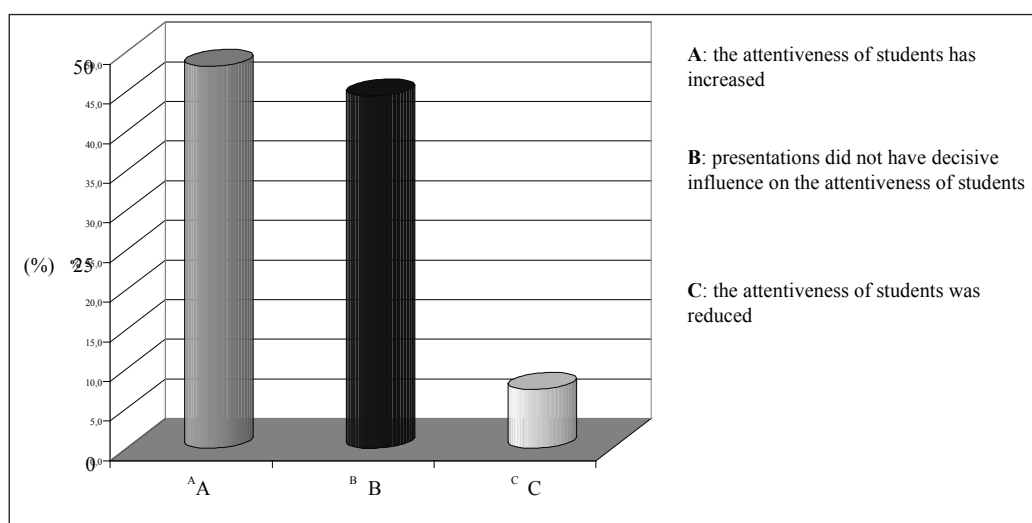
## Results of Research

Surprisingly good were the results of that part of questionnaire which was devoted to the technical equipment of schools. All teachers stated that their schools possess the technical equipment necessary to introduce computer presentations in their classroom teaching. However, the outcome of the investigation shows that individual schools apply different strategies for the selection of technical equipment as illustrated in the following table.

**Table 1. Technical equipment of secondary schools.**

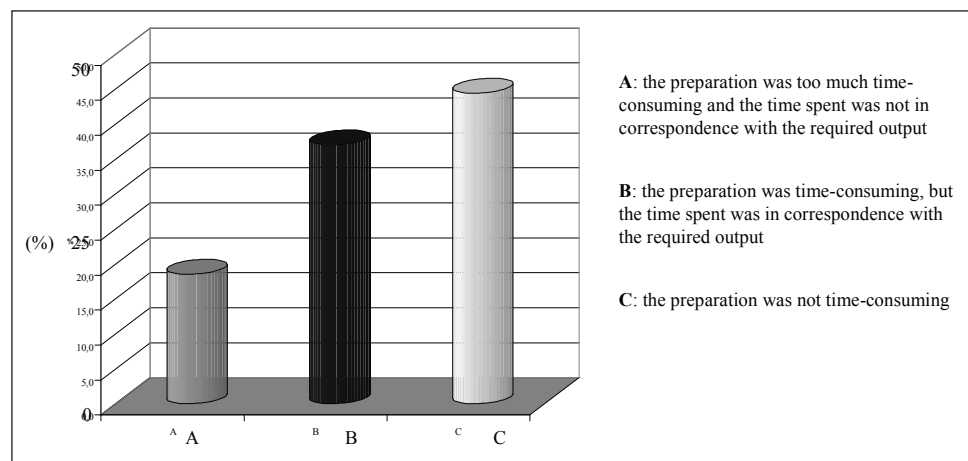
Technical equipment for computer presentations	Number of schools (%)
Subject-field classroom equipped with computer and data projector	35
Other classroom equipped with computer and data projector available	30
Notebook and portable data projector	30
Notebook and stationary data projector	5

Further results were obtained from closed items of the questionnaire. In total it can be assessed that teachers expressed their positive opinions on the questions of the used graphics, the use of tasks and questions in the presentation, the use of diagrams, pictures and animations. Crucial questions arising from this research were related to the influence of presentations on the students' attentiveness and curriculum comprehension. Figure 1 expresses a summary of answers to the question targeted namely to the attentiveness of students. Column A shows a percentage of teachers who think that the attentiveness of students in the classroom teaching supplemented with presentations has increased, column B represents the opinion that presentations did not have decisive influence on the attentiveness of students, and column C shows a percentage of teachers who thought that the attentiveness of students was reduced. A summary of answers on the question related to the influence of curriculum comprehension in classroom teaching supplemented with presentations was very similar.



**Figure 1. Attentiveness and interest of students in classroom teaching supplemented with presentations.**

In terms of effectiveness of teaching, the questionnaire also monitored time demands on the preparation of teachers for the classroom teaching with a pre-prepared presentation. The results of this item are illustrated in figure 2. Column A shows a percentage rate of the opinion that the preparation for classroom teaching with presentations was too much time-consuming and the time spent was not in correspondence with the required output, column B represents the opinion that the preparation was time-consuming, but the time spent was in correspondence with the required output, and column C represents the opinion of the teachers that the preparation was not time-consuming.



**Figure 2. Time demands on the preparation of teachers for the classroom teaching with a presentation.**

After categorisation, the conclusions of questionnaire open items were divided into four areas, which were the most frequent focus of teachers' opinions: format and arrangement of presentations, influence of presentations on teachers, influence of presentations on students, influence of presentations on classroom teaching. Within the individual categories, the opinions of teachers were summarised into the following formulations:

Format and arrangement of presentations: beneficial are slides containing pictures or animation, too much text in the slide disturbs attentiveness, and too much information in one slide reduces the extent of curriculum comprehension.

Influence of presentations on teachers: more interesting work for teachers, facilitation of teacher's work, better contact between the teacher and the students, worse contact between the teacher and the students.

Influence of presentations on students: some students lose attentiveness, increase of students' attentiveness, increase of students' interest, students are passive, positive influence as alternation in activities, teaching is more attractive for the students, facilitation of note-taking by the students during the lesson.

Influence of presentations on classroom teaching: teaching with presentations saves time, teaching with presentations is time-consuming, teaching is better organised, teaching is more illustrative, presentations make the teaching more diversified, teaching is complicated by a poor availability of equipment in classrooms, and teaching is negatively influenced by the necessity of making the classrooms dark.

## Discussion

The obtained results brought about several interesting information. As stated above, in all schools where the investigation was carried out, technical equipment necessary for teaching with computer presentations or other similar tools is available. Demands on preparation for teaching and therefore also the decision of teachers whether this teaching tool should be used or not is then directly dependent on whether this equipment is available within the school. Complications can be caused by the necessity of booking the portable equipment or classroom, which is specifically designed for these purposes, connection of the portable device or organisation of students' groups in case the lessons are held in other classroom than it is common.

The answers to the questions whether classroom teaching supplemented with presentations increases the interest of students in the curriculum, increases attentiveness and contributes to better comprehension of the curriculum are more complex. The results of questionnaire closed items and also the results of teachers' reactions in open items show that a considerable part of the teachers think that the interest and attentiveness of students have been increasing. However it is necessary to mention that at the same time especially these teachers often refer to a positive influence of presentations in relation to the alternation in students' activity. From this it can be concluded that higher interest can often be influenced by "novelty" effect, which means that a longer-time application of the teaching tool can lead to a decrease of students' interest. This conclusion, of course, does not mean that this is not a positive fact and that it should not be used. It is, however, evident that if presentations became an everyday component of the classroom teaching as a whole, as it is already very often common in lectures at universities, a decline of both interest and attentiveness of students could be expected. A contribution to the increase of teaching effectiveness would then be minimal.

The results of questionnaire open items bring about another interesting fact. From different teachers, fully contradictory opinions on e.g. contacts between the teacher and the student are obtained. From this it can be concluded that not only perception of teaching by different teachers varies, but also most probably the whole teaching with presentations performed by different teachers will differ. This finding corresponds to similar results of research conducted at universities (Hardin, 2007). Therefore it can be stated that with the use of the same teaching tool the unified results and impacts on educational process cannot be expected, because a very important role is played by the capability of teacher to work with this teaching tool, his/her previous experience with similar teaching tools, his/her age, focus, etc.

As for the presentations themselves, here the opinions of teachers were relatively uniformed. Consequently, the teachers do not consider as beneficial for classroom teaching to include presentations that contain only a text divided and structured in the form of slides and bullets on these slides. On the contrary, they consider as beneficial those presentations that will offer a maximum of visual nonverbal elements such as pictures, animations, diagrams, etc. The investigation further showed that it is desirable to include into presentations the most possible number of elements that encourage students' activeness i.e. involvement of tasks, questions, open sentences or diagrams which can be completed, etc. Presentations prepared in a traditional interpretative way lead to a rather passive approach of the students than to their active involvement in the teaching process.

## Conclusions

On the basis of this research it can be stated that teaching presentations, which are well prepared, and which contain a sufficient number of visually illustrative parts and elements intended for activation of students, have their place in secondary school teaching of chemistry. Should the teachers obtain appropriate conditions and technical background, this didactic tool can positively influence the effectiveness of teaching. However this conclusion cannot be generalised.

Definitely, should the presentations be used effectively, then it is necessary to alternate the teaching supplemented with presentations and other didactic tools and students' activities.

The research, apart from answers, has also arisen, without any doubt, a lot of questions that could be a base for further investigation. Seeing that this research was mainly focused on the opinions of teachers, it would be desirable in future to focus on the opinions and experience of students. It would also be interesting to compare the opinions of students and teachers. A similar comparison within tertiary institutions showed how markedly the views of these two groups differed (James, Burke, Hutchins, 2006).

It can be assumed that tools of information and communication technologies will further penetrate into the teaching process, and schools will strive, about as it can be, to supply and renovate their technical equipment. This is also conditioned by the economic pressure on the part of companies and commercial sphere on all types of educational institutions. Therefore it is necessary for the specials from the area of subject-field didactics to make efforts and search for appropriate ways of using these technologies so that they can be fully exploited and at the same time the possible negative impacts of these technologies on the educational process could be identified and eliminated.

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