

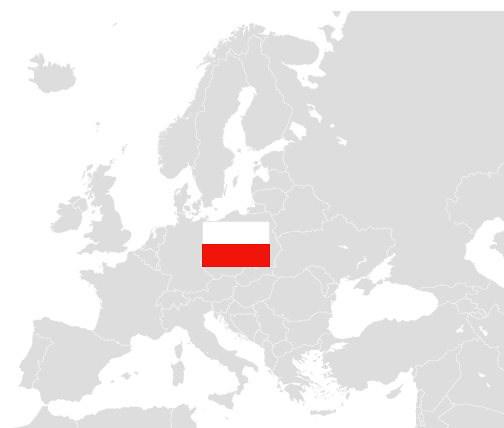


Wyższa  
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# Chemistry Teachers' Training in Poland



Lifelong  
Learning  
Programme

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## Chemistry Teachers' Training in Poland

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### ABSTRACT

*The following report is an integral part of the project documentation and presents the national situation in Poland with reference to chemistry teacher training and science teachers in general. It briefly introduces the initial and pre-service teacher training, listing the most prestigious and best recognized higher education institutions in Poland offering courses and programmes for prospective chemistry teachers both at Universities as well as Technical Universities. In the second part the report tackles the details of the in-service teacher training and it concentrates on the methods and didactic techniques applied to train and develop a practising teacher's career. The last part of the report focuses on the overall evaluation of the Polish national situation mainly with the use of the Polish teachers' comments and review of the Polish publications on the teacher training. Finally the role of the project in the teacher training will be mentioned; its impact on bridging the gap between the practising teachers and experts and its influence on the end user – the student. The exchange of the views of educational and scientific sector representatives could lead to better consolidation of common policies and methods facilitating wider interest in scientific subjects at schools and universities.*

### 1. National Situation on Teacher Training in Poland

Polish higher education has been undergoing a serious of reforms and modifications so that it becomes more compatible with the European higher education sector. Under the Bologna process Polish universities and Technical Universities have implemented procedures in order to make Polish system more up-to-date and flexible with the graduate's knowledge, skills and social competences in mind. Curricula of all the programmes have been restructured especially those which involve teaching and training of prospective teachers. The Ordinance of the Minister of Science and Higher Education from 17 January 2012, which was also signed by the Minister of Education is currently in force. The standards of training leading to the teaching profession are defined in this ordinance. The ordinance regulations specify:

- a) the learning outcomes across the range of expertise and methodology (cross curricular), pedagogy and psychology, application of information technology and foreign language proficiency,
- b) the duration of studies and postgraduate studies,
- c) the size and organization of practical training for teachers.

In the new standards the two-specialization education, obligatory until now in the first degree, was rejected. The process of preparing teachers for their work is modular and its implementation will depend on the course of study and graduate and postgraduate studies. Pathways to education of a teacher will be conducted in three compulsory modules, including the substantive, psycho-pedagogical and didactic preparation for teaching (preparation to conduct the course). This education will be expanded to optional modules including preparation for teaching another subject (preparation to conduct the course), and the background in special education. Teacher training relies mainly on getting practical skills needed to work as a teacher. In turn, theoretical knowledge supports the acquisition of these skills and gives a scientific synthesis of obtained experience. Thus, the discussed Regulation leads to increase of the role of practical training, in particular in the areas of competence of the care, education and diagnose of individual student's needs.



### 1.1. Initial Teacher Training

Universities provide programmes which prepare students for the teaching profession in academic education and post-graduate studies in the relevant training modules. They can be divided into two major paths:

I cycle programme (Undergraduate courses)

Bachelor's studies last at least 6 semesters, and the number of hours should not be less than 2200 ( $\geq$  180 ECTS points). The graduate of these studies should have knowledge and skills in general chemistry topics, based on mathematical and natural sciences. Engineering studies last at least 7 semesters, and the number of hours should not be less than 2500 ( $\geq$  210 ECTS points). Engineering graduate should have the ability to use the basic knowledge of chemistry and chemical technology, based on the broad-based mathematics, natural sciences and engineering.

II cycle programme (post-graduate courses)

Post-graduate programmes take not less than 4 semesters, involving undergraduate alumni. Number of hours should not be less than 1000 ( $\geq$  120 ECTS points). However, in the case of engineering graduates in postgraduate courses last not less than three semesters, involving engineering graduates and the number of hours should not be less than 900 ( $\geq$  90 ECTS points). Graduates should have an extended (according to first degree) knowledge of chemistry and demonstrate a proficiency in the chosen specialization. He/ she should have the knowledge and skills leading to solve chemical problems in non-standard situations.

Currently after the new reforms Chemistry teacher training takes place during the second-cycle of studies and includes mandatory training in the following areas:

- 1) substantive education for teaching of first subject (preparation to conduct the course) – first module;
- 2) psychological and pedagogical education – second module;
- 3) didactic education – third module.

The preparation to work as a teacher during the academic education can be extended to optional preparation for teaching of another subject (to conduct the course) – fourth module.

However, the preparation to work as a chemistry teacher at postgraduate studies may be conducted in the following areas:

- 1) preparation for teaching of another subject (to conduct the course) – fourth module;
- 2) psycho-pedagogical and didactic preparation for graduates with substantial preparation for teaching (to conduct the course) and without psycho-pedagogical and didactic preparation – second and third module. The implementation of each module, both in academic education and post-graduate studies, should lead to the attainment of the same learning outcomes. The implementation of module 2 and 3 should take a total no less than three semesters. The third module is implemented after the second module. The training in the range of the fourth module is taken by students or graduates preparing for the teaching profession, who intend to prepare to teach more than one subject. The fourth module may be implemented parallel to the third module or on completion of the third module. The implementation of the training modules accordingly is presented in Tab. 1.

Table 1. Implementation of the training modules

Module	Module components	Hours	ECTS credits
1. substantive preparation for teaching of the first subject (of course)	Substantive preparation according to description of training results for implemented field of study	*	**
2. psycho-pedagogical preparation	general psycho-pedagogical preparation	90	10
	psycho-pedagogical preparation for teaching	60	



	in the education stage		
	practise	30	
3. didactic preparation	didactics basics	30	15
	teaching of subject in the education stage	90	
	practise	120	
4. preparation to teaching of another subject (of course)	substantive preparation	*	**
	teaching of subject in the education stage	60	10-15
	practise	60	
5. preparation for special didactics	psycho-pedagogical preparation	140	25
	special didactics	90	
	practise	120	

\* dimension that provides academic preparation for teaching

\*\* the number assigned to the objective course of study

Post Diploma studies are designed for teachers who wish to improve their qualifications by updating of their knowledge and practical skills necessary for chemistry teaching in lower secondary and upper secondary schools. Recruitment for the study includes people who have completed their master's degree in chemistry or engineering or related fields of chemistry (among others biology, physics). A graduate of postgraduate studies can obtain the most up-to date knowledge of general chemistry and inorganic, organic and physical chemistry necessary for teaching in lower- and upper-secondary schools and implement the information technology resources to support the teaching of the subject. They usually constitute a part of the professional development process of in-service teachers.

## 1.2 In-service Teacher Training

The majority of the in-service training for teachers of Chemistry in Poland is organized on the voluntary basis. There are no obligatory requirements for teachers meet and courses to complete in order to teach chemistry in Polish schools. Their university education expanded with practical teaching component is the only must have. Teachers engage in the development of their careers on their own and they care about their professional improvement due to the general directives of teacher training. Trainings, workshops and seminars participation and attendance are only a part of their professional activity. In order to advance and climb their professional ladder they must follow general 4 level teacher development path from novice teachers to the diploma ones.

A series of regional and local institutions offer trainings of various kinds for practising teachers, which is a great opportunity to comply with Ministerial requirements and hold a higher teaching degree. For example the Regional In-Service Teacher Training Centre in Lodz is a public educational institution. The main aim of the centre's work is to support the education environment in achieving aims of the educational reform and in aspiration for proqualitative changes. The centre is also seriously engaged in the integration process of local educational community. It offers over 170 various forms of training for school principals, teachers and local government representatives who are involved in issues of education. The main subjects of their training courses concern: quality in education, teaching problems, planning and documentation of professional development and advancement of teachers, information technology, European education, pedagogical skills and languages. The Regional In-service Teacher Training Centre is engaged in application of new pedagogical methods with the use of IT. It edits methodological materials for teachers and quarterly The Educational Review. The Centre co-operates with: Technical University of Lodz; University of Lodz, The Academy of Humanities and Economics in Lodz, The Academy of International Relations and the University of Computer Sciences and Skills. Each region of Poland has a similar institution dedicated to teacher development. A series of publishing houses oriented for scientific subjects such as ZAMKOR offer online portals for both students and teachers to help the first raise their interest in the subject, whereas the latter gain extra qualifications and skills in order to teacher in a more interesting and technologically advanced way. Teachers can also select from many high quality offers among which is the one of the Centre for



Education Development (CED). It was established on 1 January 2010, as the result of merger of National In-Service Teacher Training Centre and Methodological Centre of Psychological-Pedagogical Counselling. CED is a national teacher training institution. The Centre objectives include actions for quality assurance in education, particularly through supporting schools and educational institutions in carrying out their statutory tasks and support of changes in the system of education in the field of teachers' professional development. The new Polish science curriculum was launched in the 2008 and currently implemented in upper secondary schools. The new general objectives of education, and students' key competences that should be developed during science classes were defined in that document. Presented competences are in line with competences that might be developed by *Inquiry Based Science Education* (IBSE). IBSE is currently a popular instructional method in many countries and it is being strongly promoted by European Union. In the article the role of IBSE in the new Polish science curriculum is described and related to the method of 'Independent Investigation to Acquire Knowledge' that was formerly known in the national pedagogy.

Many universities of polytechnics organize Post-Diploma Trainings for teachers. Among others the institute of Didactics of Chemistry in Siedlce offers an interesting course for Chemistry and Maths teachers. The aim of programme is to give the person who completed the master's degree in the fields of chemistry permission for teaching chemistry in junior secondary or upper secondary school and mathematics in primary school, junior secondary school and upper secondary school. The course is also addressed at students of the second cycle courses related to chemistry or mathematics. In their case, they will be conferred the right to teach chemistry or mathematics, in schools mentioned above, on their graduation from the second degree programme (Master's degree). Within the programme of 340 hours students will gain theoretical and practical knowledge of psychological - pedagogical preparation for teaching chemistry or mathematics. Plan of Study activities and programs are tailored to the Ordinance of the Minister of Science and Higher Education of 17.01.2012 in the matter of educational standards - to prepare for the teaching profession. Students are also required to serve 155 hours practice. Another example of good practice in terms of chemistry teacher development is WCIES. It is a self-government teacher development facility – an institution providing knowledge and education, whose tasks perfectly illustrate the motto "Warsaw – the City of Education". The main objectives of the Centre include supporting the Warsaw educational environment and improving the quality of work of schools and educational facilities in the City of Warsaw through different supporting forms for teachers, include biology and chemistry teachers. The Centre has certain experience in advocating the application of the IBSE method at the 4th educational stage, primarily in the area of professional continuing education for biology teachers interested in new educational solutions. Warsaw Centre for Socio-Educational Innovations and Training has been providing a comprehensive set of activities to support professional development for science teachers for several years. Since 2009, the centre has attracted more than 2500 teachers to workshops, lectures, conferences, seminars and model lessons. Topics for lessons have included: news from the science world, new teaching methods, biological and chemical experiments and observations, and more. The training programme, based on the new Polish core curriculum in biology and chemistry, consists of lectures and hands-on learning activities provided by expert scientists from Warsaw University and Nikolaus Copernicus University in Toruń.

## 2. Assessment of the National Training of Science Teachers

Without any doubt, the key research tool of each chemist should be an experiment, e.g. experience, chemical test or proof. Chemistry teaching with the use of a well-thought experiment will be more impressive. The experiment is not only a tool of research, but it also has a huge educational value. Experiment promotes thorough understanding of chemical phenomena and teaches how to experimentally obtain answers to the posed questions. Polish Chemistry classroom unfortunately lacks this tool mainly due to financial reasons and school funds, rather than lack of skills of a chemistry course graduate. Conducting the interdisciplinary activities is also very important, because it gives teachers freedom of choice how to implement these activities. This could be, for example, the organization of activities outside school, designed to observe nature in the field, or to complete projects to raise social awareness and active citizenship. Chemical education in school can be carried out in different ways, depending on the capabilities of the school, teacher preferences and needs of





the students. It is worth noting that the technology development affects also the educational sector. It is necessary for each school to meet the challenges it has to face, each school has to be a modern school. In a nutshell, it is impossible to provide effective learning without the knowledge based on the latest educational solutions. Nowadays, electronic media complement books. Computers, tablets and interactive whiteboards are tools whose applications in the classroom are increasingly required by both students and their parents. This is not surprising. Learning through multimedia is not only interesting, but also more effective. Let us now define a good chemistry teacher's profile. Undoubtedly he or she should have a knowledge of chemistry in accordance with curriculum content of these subjects, should be able to independently deepen this knowledge, update, and integrate it with other fields of knowledge in order to transfer it properly to students. He or she should know the stages of mental development of students and can be a good guardian and tutor through knowledge based on psychology and pedagogy. Moreover, he or she should have the ability to support the intellectual development of students through appropriate teaching methods and educational measures; last but not least should know how to use information technology in the classroom and speak at least one foreign language. Finally the good chemistry teacher should be aware of the constant need of professional development. But the situation in Poland as far as teaching Chemistry is concerned, unfortunately is not all positive. More than 90 per cent of Polish teachers have higher education diploma, but only about 25 per cent. of them speak foreign languages fluently. English is known only by teachers with the short-term (up to five years) of teaching experience. Teachers with work experience of above 20 years have the lowest English language skills. This makes it difficult for chemistry teachers as they are expected to attend language courses very often free of charge. Undoubtedly, a good knowledge of foreign languages will help teachers to be able to participate in international mobility programmes, exchange their experience, establish contacts with teachers from around the world and benefit from foreign sources, preparing for lessons. Analysing the situation in Poland one can draw some conclusions. Polish student of Chemistry at University or Polytechnic is better prepared for teaching in theory than practice. He/ she has access to equipment and chemical experiments when at University and then lacks the opportunity to experiment when starts proper teaching at schools, which do not even have properly equipped chemistry laboratories. Another downside is the educational reform in Poland itself which according to some experts interfered with the core curriculum development - for the last few years it got changed few times which results in disorientation and lack of cohesion of ministerial requirements and the factual learning outcomes and teaching objectives. What is more, according to ministerial regulations a Chemistry teacher is supposed to develop professionally (as it was mentioned above each teacher in Poland follows a career development process – 4 stages) but during the process his/ her chemical knowledge is not much verified. Their pedagogical skills are verified, however chemistry experimentation and core chemistry issues lack monitoring. There is an offer at few institutions of some professional development, refresher training available for in-service teachers but courses, workshop, conference and training organized by them are not mandatory, and usually if of higher quality, also quite expensive. On the other hand, such courses help teachers enrich their classrooms with cutting edge developments in the exciting field of nanotechnology, learn new pedagogical approaches to teaching science, provide teachers with the opportunity to refresh their understanding of core science concepts and to connect with their peers. One semester long course meets weekly and the 3 hour class is broken into 3 segments: a/ Teachers are immersed in chemical research via laboratory tours, demonstrations, hands on experiments, or lectures from graduate students. b/ Teachers discuss how to most effectively bring this research into the classroom, develop lesson plans and reflect on how they have used the course in their teaching. c/ Teachers are equipped with chemistry fundamentals and provides with alternative teaching techniques to improve student learning by provoking thought about experimental observations. The goals of this development program are to expose teachers to the research environment, to reinforce each teacher's sense of science as a process, to deepen each teacher's understanding of the achievements and potential of chemistry, and to apply lessons learned from the content class to a research setting a scientific discovery. As seen above the Polish chemistry teacher has to cater for his/ her professional development on the individual basis which may result in the lack of motivation and loss of quality of teaching. Last, but not least, as it was mentioned above,



the Polish Chemistry teacher lacks good English language skills which is very limiting and can slow down self-teaching and restrict use of teaching solutions applied by foreign chemistry market.

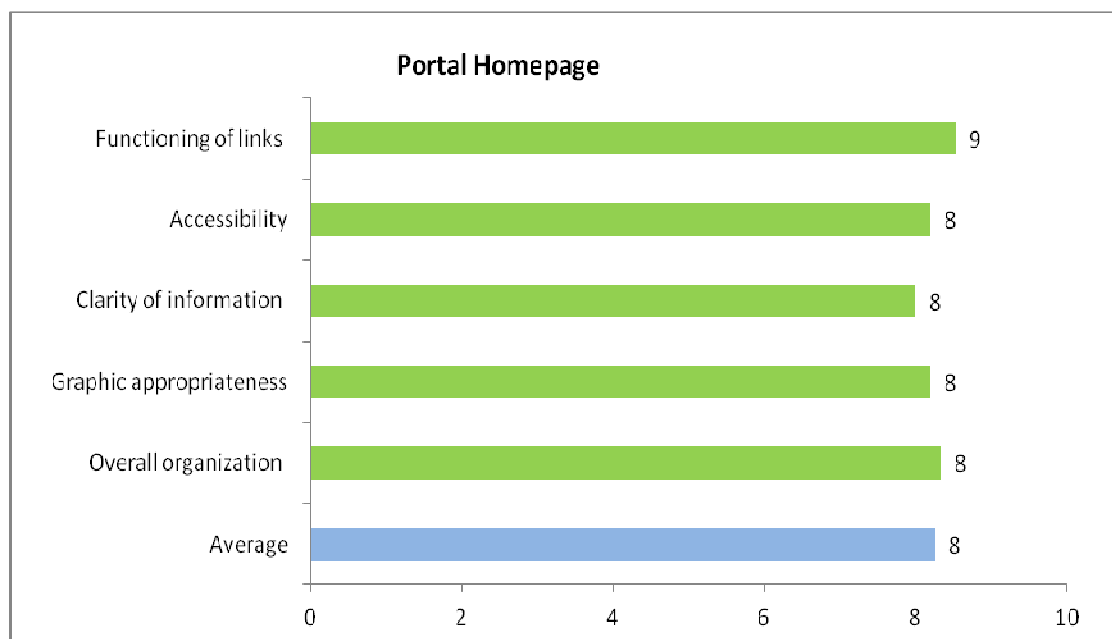
### 3. The Impact of the Project on Teacher Training

Chemistry is All Around Network project's requirements are more than compatible with the higher education market as far as teacher training is concerned. Its great part is devoting to teaching and teachers of chemistry in particular. Its first year activities concentrated on arousing students motivation and interest in scientific subjects with tools and didactical methods listed on the database. Publications, articles and papers collected shall constitute a great deal of useful teaching aids and materials sometimes to be ready used in the busy teacher's classroom or laboratory. Second year project activities focus even more thoroughly on the teachers themselves. All the project tasks are oriented for the development of chemistry teacher; with great deal of focus on his/ her university education and training, as well as initiatives of post university qualifications and skills which should be appreciated especially by in-service teachers. A database of collected publications and articles lists all necessary prerequisites for students first to enrol the chemistry course at the higher education institution, then for graduates to finish their compulsory education at University or Technical University with methodology and didactics in mind, and finally it defines the prerequisites for novice and in-service teachers either to begin their successful career in teaching or master it and develop further. In each year of the project each partner has to organise a workshop for teachers and experts whose main task will be to share knowledge on the project issues, exchange views and opinions between practising teachers and experts in order to prepare teacher training offer better tailored for the labour market. According to the project requirements in the first year of the project WSIU organised a workshop on students' motivation to learn and study chemistry, whereas the second year of the project has seen a workshop on the topic of chemistry teacher training in Poland. In both workshops teachers and experts had a chance to discuss the project activities and get acquainted with their objectives but most importantly they were able to bridge the gap between the 'world of science' and 'teaching chemistry reality at Polish school'. The main part of both meetings was occupied by presenting the portal resources with reference to materials collected for teachers and novice teacher and analysis of the quality of materials provided. Participants were also able to discuss the Polish situation with reference to teaching and educating prospective teachers of chemistry and motivating young people to study the subject further on their own. In both workshops a fierce discussion took place. During the latter workshop the discussion was started with a short presentation of the Polish situation to let everybody realize the facts and figures and general career path development of an average chemistry teacher. Teachers and experts were briefly reminded how long the basic training takes place with reference to hours and years and compared the ratio of theoretical and practical training for the average student. The most controversial bit which resulted in the long debate was pointing out the amount of hours spent in labs involved in experiments and comparing it to the hours spent with the end user – student, in case of teacher training specialisation. Some drawbacks were also pointed out. Lack of cohesion of the curricula; little financial resources to equip schools with labs in order to let the teachers and students experiment. And last but not least poor English language skills of graduates of technical and scientific courses. Some solutions were suggested: Financial resources from the government to equip schools better and allow teachers to participate in free or at least cheaper, high quality trainings; Access to initiatives such as Chemistry is All Around Network project and its free of charge resources; Language courses for chemistry teachers such as the one undertaken by the Jagiellonian University – an interactive course of an English language for students of chemistry programmes. Teachers and experts were generally quite positive about the contents of the workshop – those who were generally positive about the project and the portal recourse available online on the Chemistry is All around Network platform found it useful and for those, so far quite reluctant to cooperate fully, some bits of the workshop were difficult and the portal not user-friendly. Technology mattered here a lot as some teachers complained about poor internet connection at home when they wanted to work on some parts of the portal. Teachers appreciated the Polish language version of the portal very much as thanks to Polish translation it become more user friendly and accessible. Among many tasks during the workshop, teachers and experts were supposed to complete the evaluation form of the Chemistry is All Around Network portal, which was supposed to be submitted to the project



promoter by WSIU. To perform this activity each project partner was sent an evaluation form to distribute among its teachers and experts during the workshop. The form contained questions about teachers' personal details: age, gender but also professional background e.g. years in the teaching profession. As it was mentioned above teachers mostly have from 5-15 years of teaching experience and are between 25 and 55+ years of age. In their professional carriers they admitted to working with different target groups: school children (before the educational reform in Poland Chemistry was taught in primary schools), adults and professionals. In the further parts of the portal evaluation questionnaire teachers were asked various types of questions to voice their opinion on the structure, layout and the contents of the project portal.

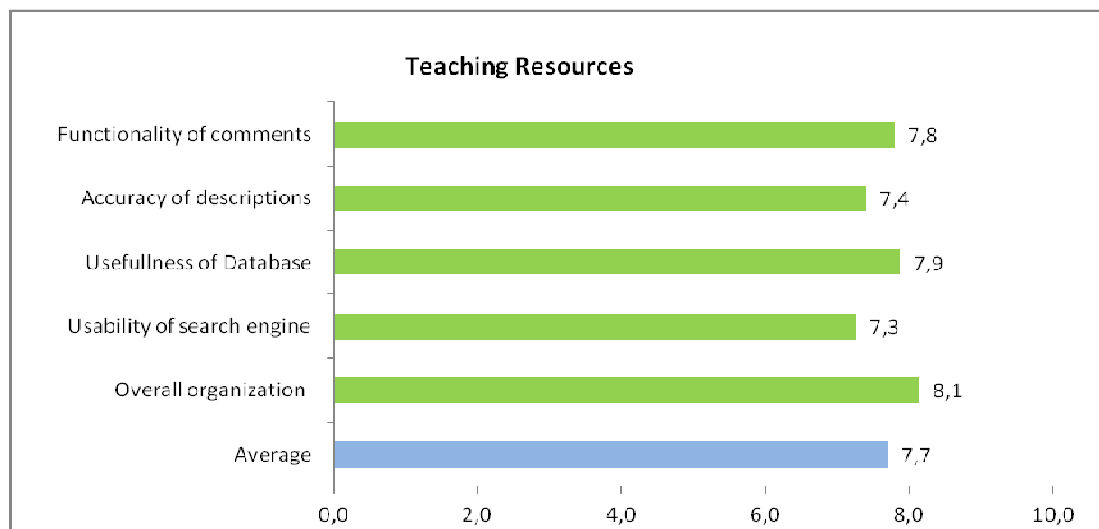
With reference to the evaluation of the Chemistry is All Around Network portal Homepage Polish teachers gave it an average score valued 8.0 out of 10. Check the graph below for more details. Some teachers were very positive about its structure and layout, others more critical in this matter. As far as Graphic appropriateness and clarity of information are concerned teachers in Poland scored them both for 8.0. It is difficult to interpret these results as not many comments were made about this section. One can only assume that this could be a personal, subjective opinion on the topic. As far as accessibility is concerned it score 8.0, too whereas functioning of links went up to 7 points out of ten. Teachers pointed out that some of them had problems with checking the content of the links as it required a password. For a busy teacher, as they said, waiting for the password to be sent, is too time consuming an activity. The overall organization of the portal scored 8.0 similarly to the other scores in this section.



*Graph 4 . Polish teachers and experts' evaluation of the homepage of the portal*

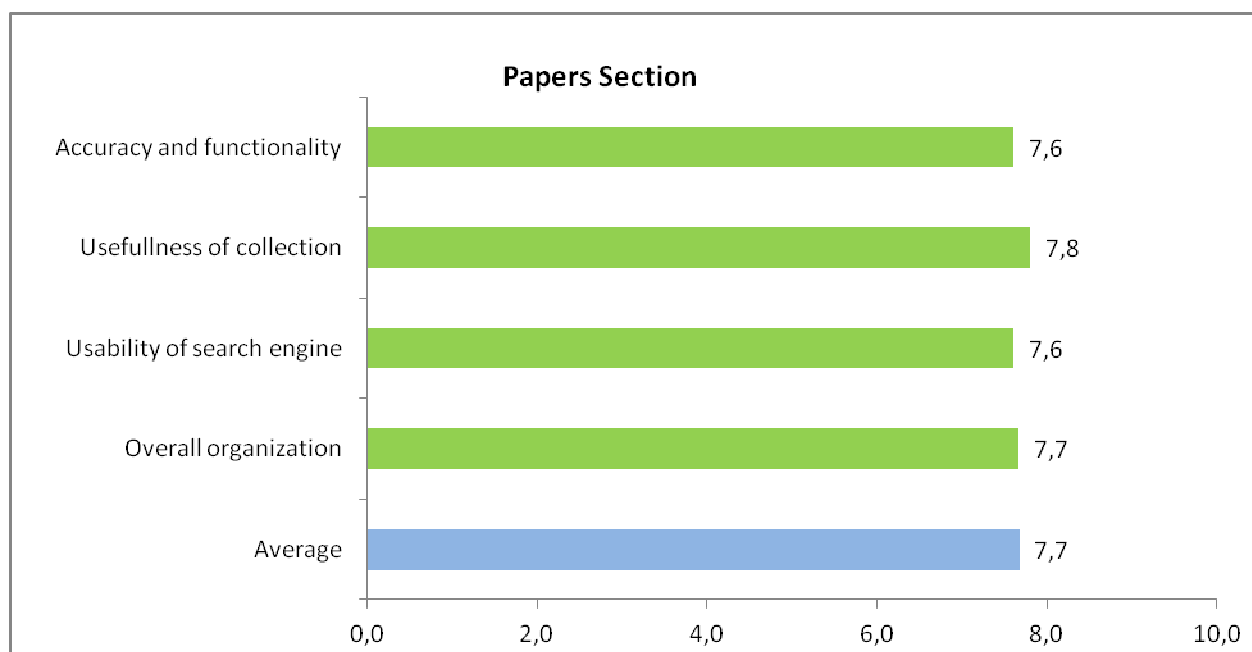
The Teaching Resources section score between 7.3 (the lowest score) and 8.1 (the highest score) for all the questions, making the average 7.7 out 10 points. Teachers found this section quite useful and well organized. Information was clearly presented and easy to refer to. Many pointed out in their comments that they liked consistency of this database of products as the common layout surely made the navigation easier and faster. Some however complained about the non accessibility of some materials due to their original language. Even valuable materials available in other than Polish language maybe a little bit putting off for some. in See graph 5 for more detail.





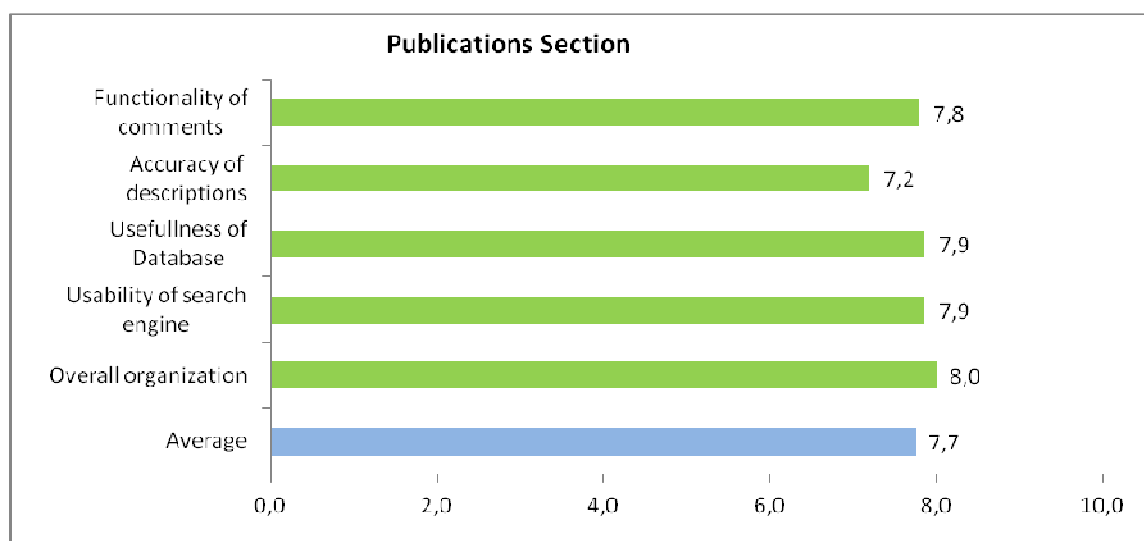
Graph 5. Evaluation of the Teaching Resources section

As far as the Papers Section section is concerned it scored similar values to resources section in terms of the average score. In terms of overall organization it was similar score 7.7 (out of 10) to the average. The highest scored was the usefulness of the collection (7.8); many teachers and experts admitted there is a huge demand for electronic resources, papers and publications available online, free of charge in one place; where they can be easily reached for and referred to for lesson preparation, research and further exploration of both academic and scientific content. Accuracy and functionality scored lowest values (both 7.6 out of 10). Teachers changed their view on the quality of the google translator tool, some really appreciated it a lot. As far as the usability of the search engine is concerned some concepts may not have been functioning well but not many comments were made on that issue that is why it is really difficult to evaluate it objectively.



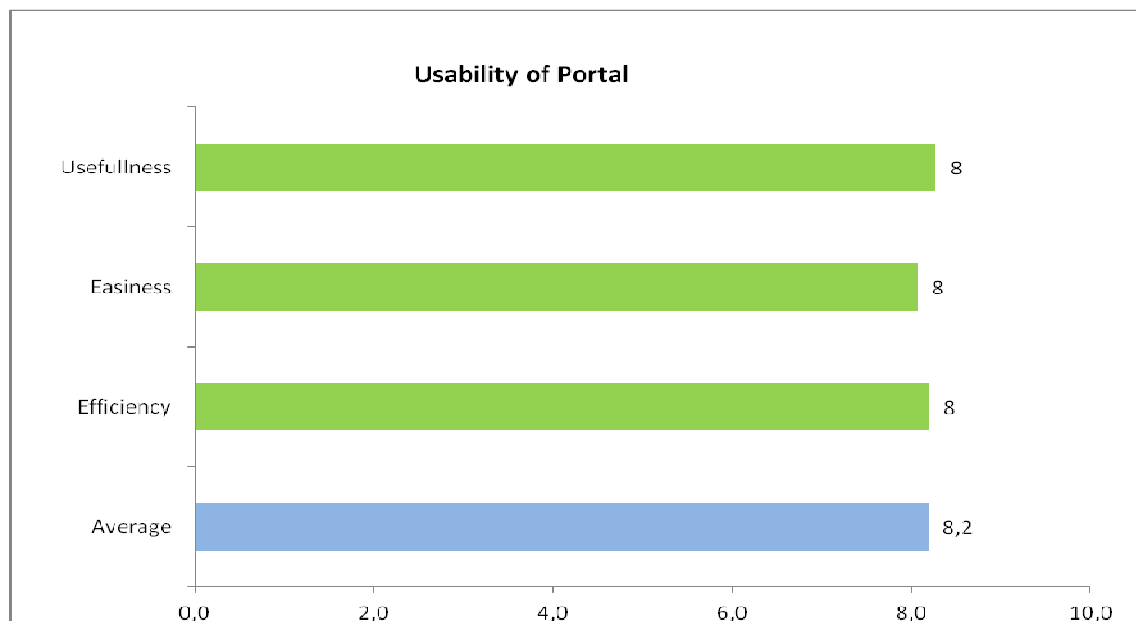
Graph 6. Evaluation of the Papers section

Polish teachers were quite positive about the Publications section. Many admitted it was well-designed and easy to navigate which ended up in the score for overall organization of this section the highest of all 8.0. Most teachers appreciated graphical layout and the usefulness of the database in general, as well as the usability of the search engine. Both of them score 7.9 values. The least favourite, with the score of only 7.2 out of 10 was the accuracy of descriptions. Many, teachers and experts were quite negative about the structure and the quality of the descriptions. They were either too short, not giving enough information or too long pieces of text, loaded with too much information, really hard to follow and concentrate on.



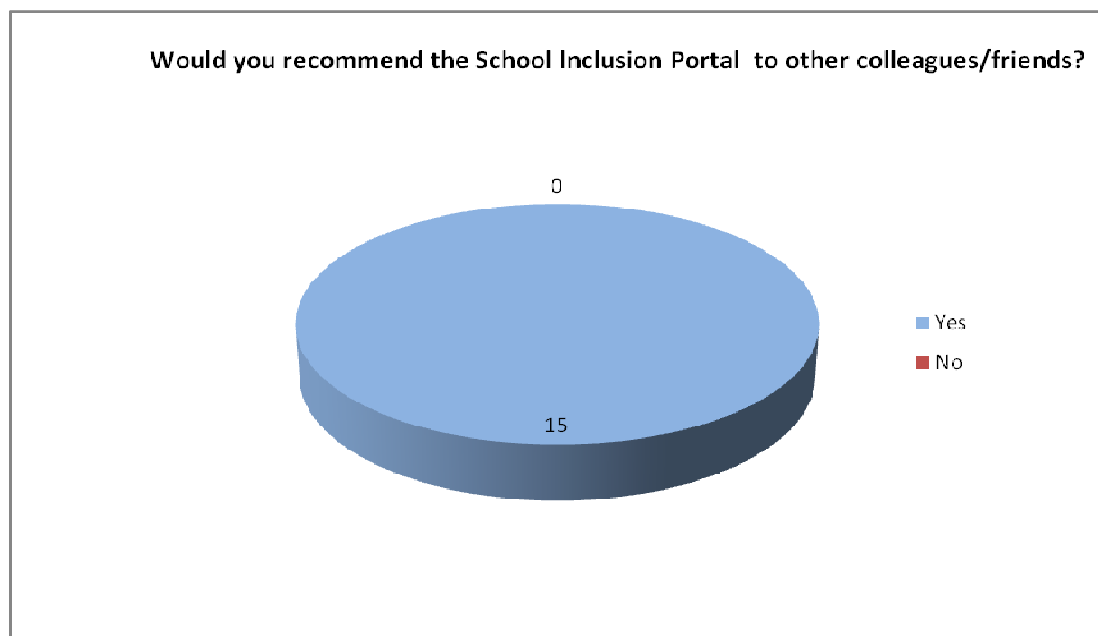
*Graph 7. Evaluation of the Publications section*

As far as the Usability of the portal is concerned Polish teachers and experts were quite satisfied with it, which was visible in their scores and represented by their comments on the above. The average of the evaluation in this question scored 8.2 out of 10 points. As it was mentioned before Polish evaluators found the portal quite easy to navigate and explore. Only some experienced minor problems with finding some information, whereas the majority suffered from the language problem. Everybody agreed on the need for such tools as chemistry resources on the portal, as surely they raise the effectiveness of the teacher in developing students interest in the subject; but what is more allow teachers to prepare more interesting and interactive lessons, despite the lack of funds. By experimenting online and plunging in the hand-on activities raise the awareness of young people of what science is for.



Graph 8. Usability of the portal

One of the last questions teachers and experts were asked in the evaluation form was about recommendation of the portal to other users. All of the Polish participants of the workshop agreed in this question and they admitted the portal is worth recommending to other teachers and experts.



Graph 9. Recommendations of the portal

Surprisingly, Polish teachers gave the portal quite a low score. Before the evaluation form was circulated everybody had seemed to be very positive about its use and content. Teachers pointed out clear layout and structure of the portal many times. However, when it came to evaluation, where



teachers and experts had to concentrate on certain specific bits of the portal it occurred they have some negative comments about it. Some complained about the operability of the portal however problems with its functioning might have been related to the connection transfer. Some teachers also complained about the publications and papers available in national languages; they did not mind Polish papers and resources but were quite critical about resources available in other languages than Polish or English. Some were not quite happy with the google translation as it lowered down the quality of the original articles, other appreciated it in a very clear way. Resources collected by partner countries were quite positively evaluated but some teachers said they did not have interactive classrooms and they obviously would not be able to take full advantage of the materials. Below there are some testimonials that WSIU collected from teachers during the workshops.

- *"I'm new to the project but I can say the portal is something a busy teacher needs. I loved the section of student motivation resources best, so did my students."*
- *"The portal is very useful for my teaching practice. Not only it is a source of numerous interesting activities but it is also far more compatible with the low motivation of students"*
- *"As a primary school teacher I always thought we lack materials for children which are both comprehensive and funny. Thanks to this portal I have lots of new interesting ideas to be used with my students. I like the fact the portal is available also in Polish"*
- *"This portal has been a great help to me in my lessons. Moreover, everything is well organized and easy to follow. I liked the resources for teachers about career development as I am currently applying for the next degree in my career."*
- *'...it is definitely an issue to consider implementing such activities as those presented on the portal in the school curriculum because they facilitate learning process and allow students to work at their own pace which gives them the feeling of control and authority over their knowledge acquisition process.'*
- *"Well-built portal summing up the situation in Poland. A useful collection of resources for teachers. Plenty of them are ready to be used in the lesson. I appreciate the collection of materials which include animations and interactive experiments in the teachers' resources section"*

#### 4. Conclusions

In the course of the chemistry teaching it is extremely important that the teacher could acquaint the student with practical aspects of chemistry and implement and complete educational and tutorial objectives at the same time. Not without significance is the awakening of students' natural curiosity to substances and phenomena that surround us. It seems that crucial teacher skills and information useful in everyday life should be one of the main objectives of the chemistry science. It is certain, that is not enough to complete the chemical studies to be a good teacher of chemistry. The continuous improvement and training are equally important. The teacher should do this to share his passion of science with his or her students. But to share his or her passion the teacher should be first of all equipped with the necessary knowledge, skills and social competences which Polish university courses are greatly responsible for. Initiatives sponsored by the government, non-governmental organizations or EU projects and private initiatives could also facilitate the process of professional development of a Polish chemistry teacher.

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