

# TEACHERS' VIEW ON THE LOWER SECONDARY CHEMISTRY CURRICULUM IN THE CZECH REPUBLIC

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## Abstract

*The research was focused on the teacher's opinions about the key and critical points of the lower secondary chemistry curriculum in the Czech Republic. Through the interviews with 40 chemistry teachers from four Czech regions was gained information about what teachers named as critical topics and what as key topics in early chemistry school contents. Some problems were identified mainly with cognition overload of learners and the necessity to realize stronger connections to everyday life and forming science literacy.*

**Keywords:** *chemistry teachers' opinions, early chemistry education, key points of the curriculum, critical points of the curriculum.*

## Introduction

Chemistry is still among the most difficult and least popular subjects taught on the lower secondary school, despite some positive progress in recent years (Grecmanova & Dopita, 2007; Höffer & Svoboda, 2005). The nature of the subject itself, i.e. the natural science orientation of the subject matter with a considerable degree of abstraction, supported by the application of mathematical rules, makes it difficult for learners of this age category. Not only the causes of this problem are sought, but also the paths leading to increasing interest in the issue of this discipline and thus improving the results in teaching. In the chemical section of the OP RDE (Operational Programme Research, Development and Education) project “Didactics: Man and Nature A” (Vocadlova & Mentlik, 2018) has been focusing on identifying the critical and key points of the curriculum in the early chemistry curriculum on the lower secondary school (Bilek, Rychtera, & Chroustova, 2017; Rychtera et al., 2018). Semi-structured interviews with a total of forty collaborating chemistry teachers from lower secondary schools and equal classes from comprehensive schools have been carried out by the subject didacticians (teacher educators) from all universities involved in the project during 2017 and 2018. The questions of the interview have focused on finding out the attitudes and experiences of teachers with the teaching of individual topics according to the FEP BE (Framework Educational Programme Basic Education) (MŠMT, 2017), i.e. which places they perceive mainly as critical and key (Rychtera et al., 2018).

## Research Methodology

The main research method was semi-structured interviews (recorded as audio samples) with chemistry teachers and comparison of collected data to the analysis of the subject curriculum in relevant educational national and international documents. Single items of the semi-structured interview focused on identification of concrete conditions of teacher work, their opinions on learning content and context of instruction, and other relating aspects, e.g. textbooks used, laboratory equipment, co-operation with companies and non-educational institutions etc. The research sample in part of chemistry consisted of 40 teachers from lower secondary schools. Data were analysed by method of content analysis through frequency of occurrence.

## Research Results

As part of the analysis of the audio recordings of the interviews, we found that the most critical topics for teachers were atomic structure, Oxidation state, acid nomenclature, salt nomenclature, chemical reactions, chemical equations (their notation, enumeration and calculations from chemical equations), and various chemical calculations. e.g., solution composition calculations. The frequency of identifying critical points of early chemistry curriculum (first year of chemistry teaching on the lower secondary school) is shown in Table 1 and the key points in Table 2. In particular, interestingness is the fact that teachers have identified a total of 65 critical points (284 different statements) and 91 key points (324 different statements) of the first year of chemistry teaching on the lower secondary school. In other words, almost the whole curriculum in the eyes of

different teachers can be seen as both critical and key. Nevertheless, our assumptions were largely confirmed that the critical points are, in particular, topics related to a high degree of abstraction and the necessity of using mathematical apparatus. As a rule, critical points are also determined to be also key points, so their simple elimination from the curriculum is not possible (see Table 3).

**Table 1. Critical points in early chemistry curriculum (first year of chemistry teaching on the lower secondary school) identified on the basis of interviews with teachers ( $n = 40$ ).**

Identified critical point (7 topics with a frequency higher than 9)	Identified frequency
Chemical equations	77
Chemical nomenclature	66
Chemical calculations	47
Matter structure	27
Chemical reaction	21
Chemical bonding	10
Chemical technology	9

**Table 2. Key points in early chemistry curriculum (first year of chemistry teaching on the lower secondary school) identified on the basis of interviews with teachers ( $n = 40$ ).**

Identified key point (10 topics with a frequency higher than 10)	Identified frequency
Chemical nomenclature	59
Chemical substances and their properties	51
Chemical calculations	46
Matter structure	45
Periodic system	34
Chemical equations	24
Chemical technology	24
Safety of work	16
Chemical bonding	16
Chemical reactions	10

**Table 3. Comparison of critical and key points in Early Chemistry Curriculum (first year of chemistry teaching on the lower secondary school) identified on the basis of interviews with teachers ( $n = 40$ ); the same critical and key points are marked in bold.**

Critical points		Key points	
Topic	Frequency	Topic	Frequency
Chemical equations	77	Chemical nomenclature	59
Chemical nomenclature	66	Chemical substances and their properties	51
Chemical calculations	47	Chemical calculations	46
Matter structure	27	Matter structure	45
Chemical reaction	21	Periodic system	34
Chemical bonding	10	Chemical equations	24
Chemical technology	9	Chemical technology	24

Based on the analysis of the most frequent critical as well as key points of the early chemistry curriculum, modules were created to improve their teaching and action research was used to evaluate them – see Table 4. Modules serve as a basis for revision and eventual modification of teacher teaching preparation and subsequent verification in the teaching of the subject (according to the form of the particular curriculum of the schools). In collaboration of teachers with subject didacticians, the modules are continuously modified according to the gained experience to include the optimal presentation, practice and evaluation of the subject matter of the topic.

**Table 4. Topics of selected modules for innovation of Early Chemistry Curriculum.**

Acids Nomenclature
Salts Nomenclature
Oxidation Number
Solution Composition Calculations
Atom Building
Chemical Reactions
Chemical Equations, Writing and Enumeration
Calculation from Chemical Equations

## Conclusions

The above-presented results of the research project, having the ambition to substantially contribute to the innovation in teaching the early chemistry contents and contexts at the lower secondary school in the Czech Republic. The main emphasis has been paid on the cooperation of researchers with teachers from the practice and building so-called “teacher practice community”.

The proposed procedures for innovation of the early chemistry curriculum reflect most of the parameters of the accomplished didactic analyses. Their main contribution is a wide discussion of both topics with the aim of simplifying and making available the presented curriculum as much as possible based on the experience of subject didacticians and experience gained from lower secondary school teachers. The criticalness of the eight selected topics is directly related to the learners' intellectual maturity since these are mostly very abstract themes. Therefore, a combination of them with examples of objects and activities that learners encounter or can meet both in school and especially in everyday life is appropriate.

The initial results of action research focus on validation and evaluation of the modules of innovated topics by teachers demonstrate that methodological approaches by teachers are very heterogeneous, and it is, therefore, good to unify them to some extent, for example through jointly proposed approaches. The teachers involved in the validation confirm that the learners have acquired knowledge and skill better than in their previous lessons and it can, therefore, be assumed that the basic theses of the modules are gradually confirmed.

It is necessary to realize that it is not appropriate to perceive any topic as an isolated thematic whole, but that it permeates another curriculum of chemistry. That is why it is necessary to give the learners sufficient time to fix and acquire concrete experience for the real learning of the curriculum. It has also been shown that learners need a higher degree of activation through laboratory activities, educational games and practice. It is therefore not necessary at all costs to continue to significantly reduce the content or to look for a new revolutionary way of exposing the given topics to learners, but rather to change the approach to existing practices focusing on greater learners' activity and sufficient time to practice the subject matter.

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