

WHICH SKILLS DO HIGH SCHOOL STUDENTS SEE AS IMPROVING THANKS TO CHEMISTRY



RNDr. Irena Chlebounová (Ph.D. student)

Department of Teaching and Didactics of Chemistry, Faculty of Science

Department of Teaching and Didactics of Biology, Faculty of Science

Charles University

Email: chleboui@natur.cuni.cz



ACKNOWLEDGMENT

Thanks to:

- RNDr. Petr Šmejkal, Ph.D. (Department of Teaching and Didactic of Chemistry)
- The project UNCE/HUM/024 „Center of didactic research in science, mathematics and their interdisciplinary context“



THE STRUCTURE OF PRESENTATION

1. Purpose of the study

1. The Research Question
2. Previous Studies
3. The Situation in Chemistry at One High School

2. Methodology

1. Sample
2. Questionnaire
3. Statements

3. Results and conclusion

1. Results + Table
2. Conclusion
3. References





1.PURPOSE

The Research Question:

Is there any significant difference in self-confidence of students taught by student-focused method and traditional teacher-centered method?

Previous Studies

- Hands-on activities and laboratory work ... autonomy, ability of cooperation [1]
- Cooperative learning ... higher achievements in working with complex ideas [2]
- Educational games ... the climate of cooperation, involvement and motivation [6]



The Situation at One High School

1. There were two Teachers of Chemistry with traditional teaching style (A, D)
2. One of them left school
3. Two new Teachers (B, C) using students-focused model with elements of active learning took his classes whereas the Teacher D had been teaching her class by unchanged style
4. The Comparison between teaching styles was done



NAFOUKNUTI
BALÓNKU BEZ
FOUKÁNI

2.METHODOLOGY

Sample

- Where? Eightyear high school in Prague
- Sample of Students: 120 (18 – 19 years old)
- Experimental Group: **76** (5 classess, teacher B, C)
- Control Group: **26** students (1 class, teacher D)
- When? At the end of their study
- How? Questionnaire (skills and competencies)
- Analyse: SPSS software (version 25)
 - **Descriptive statistics**
 - **Paired t-Test** at 95% confidence interval of the difference

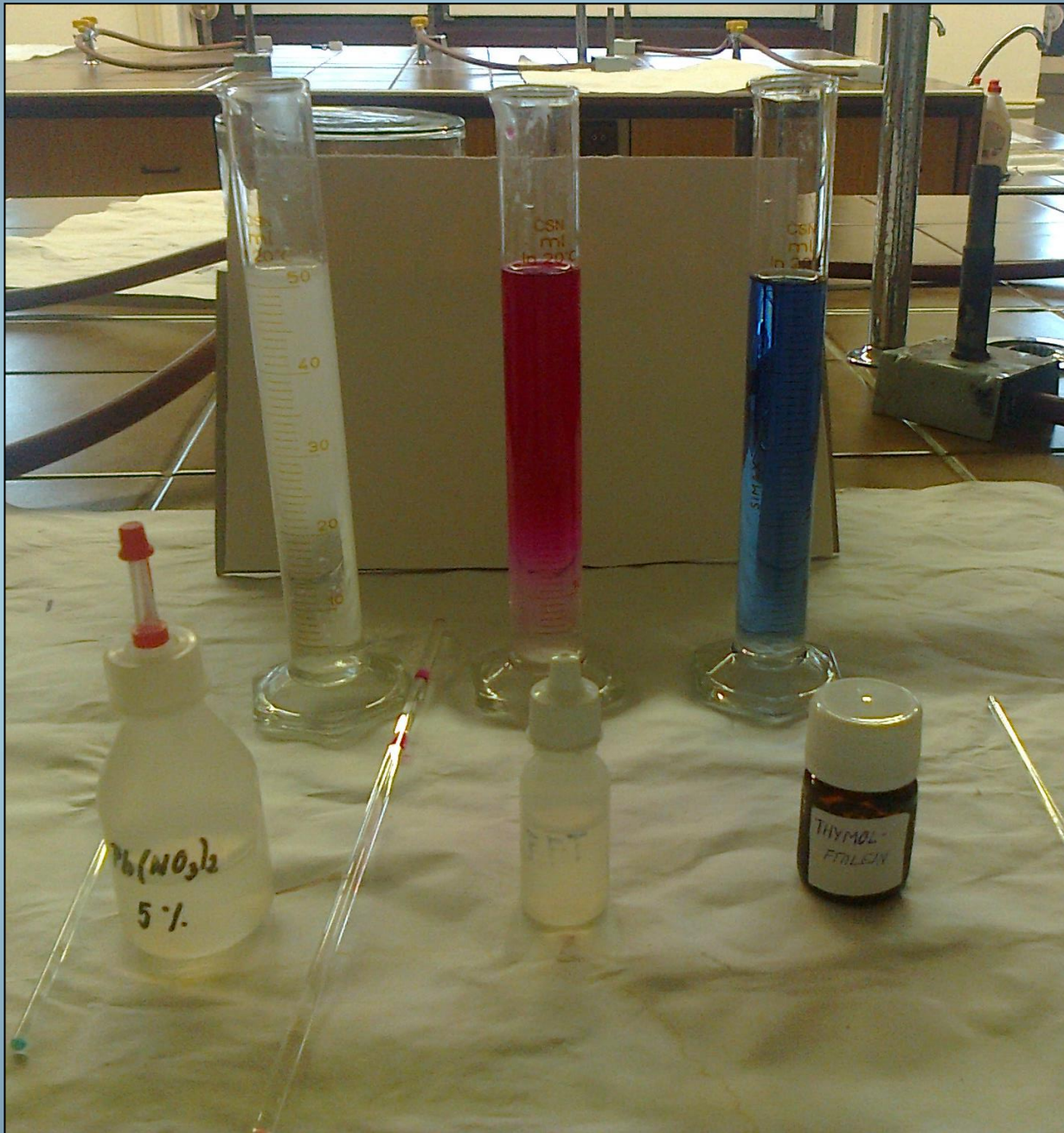
ZKOUŠKA V PLAMENI

Průběh Balónek je zesílený polymer této směsi vinné
struktura dří, uvolněná papír a dovozy balónek
vinné do určitého bílého, je vlna nebo napětí
na přímém vlny přímé vlně a dočasně je ježek
Pomůcky balónek, špička, vlněná
Příprava balónek a vlněná ho špička pomůcky
na vlně dole vlněná. Pomůcky a vlněná vlněná
(přímé) vlněná je pomůcky napětí vlněná
Zkouška je pomůcky napětí balónek
Výsledky Dřevěná vlněná balónek a vlněná vlněná
vlněná pomůcky špička vlněná bez vlněná
je ho pomůcky do vlněná vlněná



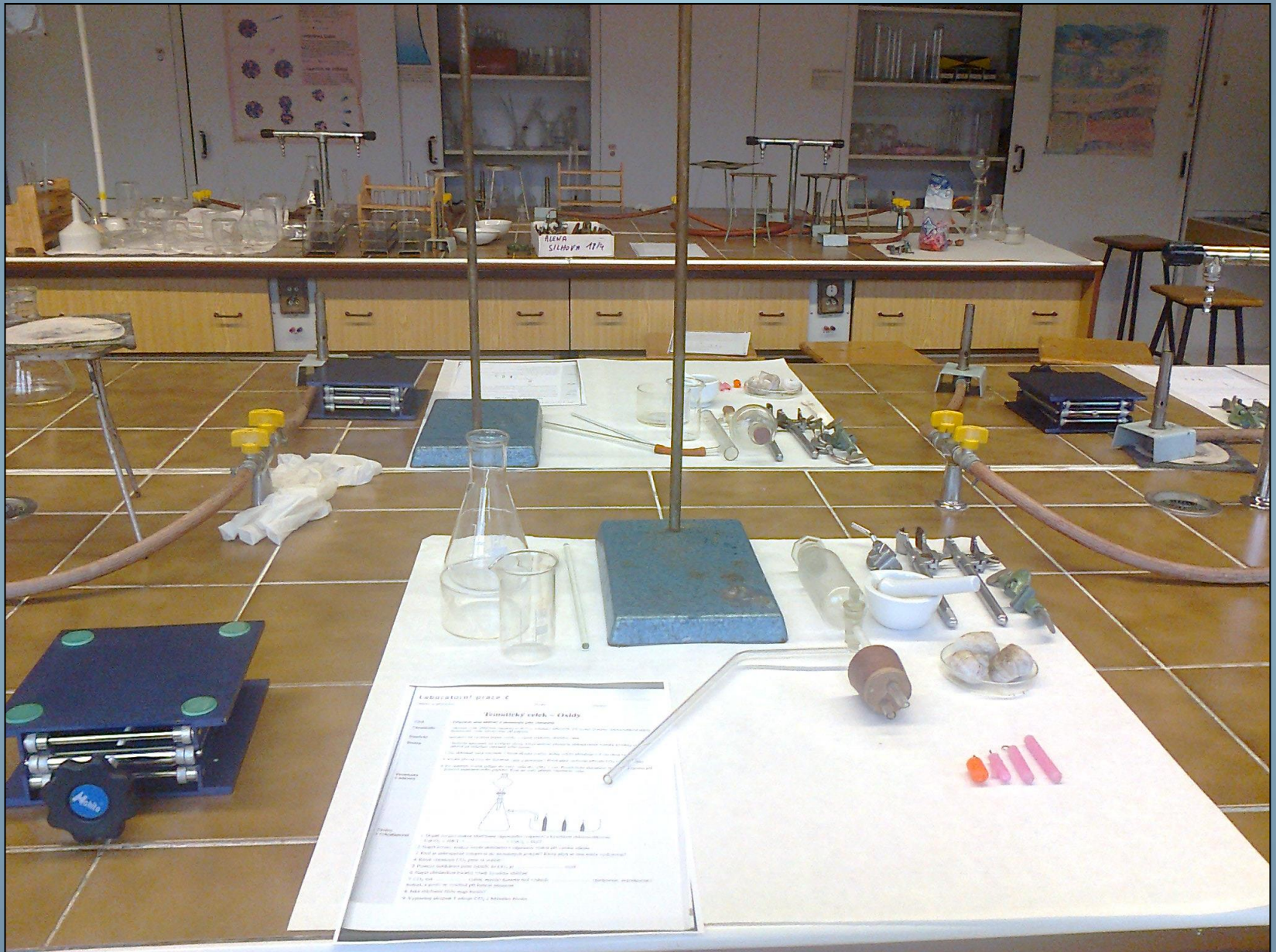
Questionnaire

- **21 statements**
- 11-point Likert scale (0 – 10)
- **33 open questions** (the explanation of the decision)
- **Pretest** (3 years with Teacher A or D)
 - A: „chalk to talk“ teacher-centered model, no laboratory work
 - D: teacher-centered model with powerpoint presentations
- **Posttest** (after next 3 years with Teacher B,C or D)
 - B + C: student-focused active learning
 - D: No laboratory work, no active learning, no hands-on activities



Statements

1. I learned the basic laboratory skills and the rules of the chemical laboratory
2. I regularly document my own work.
3. I know how to use measuring instruments.
4. I measure and evaluate my data.
5. I interpret the values written in the graph.
6. I am a valid team member. I follow the rules of teamwork.
7. I understand the context in the chemical curriculum.



3.RESULTS

- **The cooperative active learning** in experimental classes led to significant differences ($p \leq 0.05$) in **self-confidence of students** in comparison to the traditional teacher-centered model of their previous teacher in all selected skills.
- **The control group** increased students' **self-confidence only** in:
 - 1 (they know rules)
 - 4 (measuring and evaluating data)
 - 5 (interpreting the graph – because of Mathematics, Physics and German)

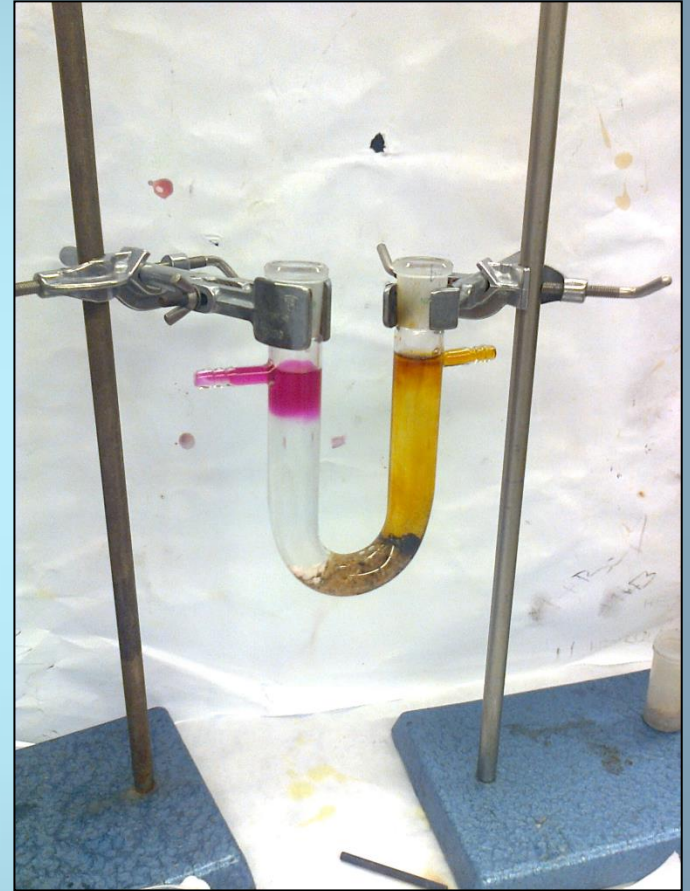
Paired Samples T-Test

(95% Confidence Interval)

Pair of Statement Pretest - Posttest	Mean Pretest	Mean Posttest	Mean Pretest - Posttest	N	Significance p (2-tailed)
1 experimental group	5.04	7.59	-2.554	74	0.0001
1 control group	3.76	4.52	-0.760	25	0.049
2 experimental	3.69	5.68	-1.987	74	0.0001
2 control	1.40	2.16	-0.760	25	0.078
3 experimental	2.03	4.11	-2.082	73	0.0001
3 control	0.88	0.81	0.077	26	0.832
4 experimental	5.38	7.26	-1.878	74	0.0001
4 control	4.50	5.46	-0.958	24	0.001
5 experimental	5.96	7.32	-1.356	73	0.0001
5 control	5.23	6.27	-1.038	26	0.001
6 experimental	6.52	7.58	-1.055	73	0.0001
6 control	6.08	6.54	-0.462	26	0.083
7 experimental	3.67	6.01	-2.340	72	0.0001
7 control	4.88	4.50	0.3846	26	0.505

REFERENCES

1. Jurišević, M. et al., "The Interplay of Students' Motivational Orientations, their Chemistry Achievements and their Perception of Learning within the Hands-On Approach to Visible Spectrometry", *Chemistry Education Research and Practice*, Vol. 13, The Royal Society of Chemistry, 2012, 237–247
2. Canelas, D., Hill, J. L., Novicki A. "Cooperative Learning in Organic Chemistry Increases Student Assessment of Learning Gains in Key Transferable Skills", *Chemistry Education Research and Practice*, Vol. 18, The Royal Society of Chemistry, 2017, 441–456
3. Tarhan, L. et al., "A Jigsaw Cooperative Learning Application in Elementary Science and Technology Lessons: Physical and Chemical Changes", *Research in Science and Technological Education*, Vol. 31, No. 2, Taylor and Francis, 2013, 184–203
4. Hong, Z., "Effects of a Collaborative Science Intervention on High Achieving Students' Learning Anxiety and Attitudes toward Science", *International Journal of Science Education*, Vol. 32, No. 15, Taylor and Francis, 2010, 1971–1988
5. O'Grady, A., Simmie, G. M., Kennedy, T. Why Change to Active Learning? Pre-Service and In-Service Science Teachers' Perceptions, *European Journal of Teacher Education*, Vol. 37, No. 1, 2014, 35-50
6. Partanen, L. "Student-Centered Active Learning Approaches to Teaching Quantum Chemistry and Spectroscopy: Quantitative Results from a Two-Year Action Research Study", *Chemistry Education Research and Practice*, Vol. 19, The Royal Society of Chemistry, 2018, 885–904
7. Mariscal, A. et al. "A Game-Based Approach to Learning the Idea of Chemical Elements and their Periodic Classification", *Journal of Chemical Education*", Vol. 93, American Chemical Society and Division of Chemical Education, Inc., 2016, 1173–1190



CONCLUSION

Students who experienced cooperative active learning

with laboratory work, hands-on activities, team work, games, excursions and positive encouraging feedback from their teacher **increased their self-confidence**

in all measured skills and competencies connected with laboratory work and work in groups.