

The Modern Sample of Integrative Teaching in Chemistry Lessons

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Abstract The following article deals with the useful, new, creative forms of integrative teaching of Chemistry in secondary schools and Lyceums creating connections between Chemistry and other school subjects. The samples from work experience are given in this article.

Keywords Dissociation, Ions, Electroconductivity, Cellule, Solution

1. Introduction

International education practice shows that to create links of integration between different subjects is the most important factor in the lesson which develops the quality of teaching. If these relationships are strong, students can comprehend the chemical process and conception comprehensively. Referring to "Bluestein J. Cherry C. 2003. Skills for Successful Teaching, USA: Brighter Child Press on page 84-91" the knowledge and skills about nature is formed completely in the students' brains due to integrative teaching. Therefore I always try integrative teaching in the chemistry lesson, especially I pay attention to knowledge of biology, physics and math that have connection with chemistry conceptions. In my practice I've become convinced that integrative teaching helps the student to get universal education. I would like to present the sample of integrative teaching lesson plan about my practice.

2. Problem Statement

The topic of electrolytic dissociation of integrative teaching in chemistry lesson.

Purpose of the Study

1) Students must be able to compare electrolytes and

nonelectrolytes systematically

2) Students must be able to explain the essence of the electrolytic dissociation

3) Students must be able to create connection between dissociation and hydratisations

4) Students must be able to create connection between the facts connected with the conceptions of different subjects (chemistry, biology, physics and math) when they research electrolytic dissociation.

3. Methods

To create situation with problem, brain storming, discussion, cluster, experimental methods related chemical experiment.

4. Resources

Instrument for controlling electroconductivity of solution, dry NaCl, NH_4NO_3 , H_2SO_4 , CuSO_4 , sugar, glucose, distilled water, alive frog, blood plasma, the presentation Power Point.

5. Activities Done in the Process of the Research

Teacher must pay attention the students' skills at the beginning of the lesson in order to stimulate the interest of the students. I had given a task to the students connected with the subject of electrolytic dissociation before teaching this topic. At the same time the students repeated the topics of the structure of atom, solutions, chemical bond, crystals, electroconductivity of materials and chemical composition of cellule. Referring to Rustamov F.A. 2010. Pedagogy. Baku: Science and Education Press on page 128 these tasks to create foundation or to pave the way for the students to comprehend new subject of lesson.

Electroconductivity of different pure substances and

solutions is checked by students with a special instrument. Then strong H_2SO_4 and NH_4NO_3 is dissolved in water and at the same time the facts of becoming warmer and colder in the process of solvation, dry CuSO_4 also is dissolved in water and is observed the change of colour - these reactions cause great interest in class and stimulate the interest of students. Then students subject the frog to weak electric current and then observe the reflex of frog. The electroconductivity of blood plasma is checked by students at last. After that I show an animation to the students about electrolytic dissociation.

I note all students, ideas and hypothesis on the blackboard which are connected with the essence of these reactions. After the motivation of students I ask the pupils questions for research:

What is the essence of the electrolytic dissociation?

I divide all the pupils into three groups and give them different tasks after putting the question for research. Referring to "Hassard J.2012.The Art of Teaching Science.London:Oxford University Press on page 104-107" when the groups solve these tasks they need to apply necessary knowledge and skills not only information on chemistry, but also on biology, physics and math together. When I define the amount of appropriate methods referring to "Bain K.2004. What the Best College Teachers Do. Cambridge, MA: Harvard University Press on page 92-98" and "Mehrabov A. 2006. Pedagogical technology, Baku: Mutercim Press on page 156-164." Pupils research in four directions as following table.

Table 1. Directions of research

Topic	Subject			
	Chemistry	Biology	Physics	Math
Electrolytic dissociation	Chemical properties of electrolytes	Ions of cytoplasm of cell	Coulomb's forces in solution of electrolytes	mathematical analysis of research
Amount of appropriate methods	4	2	3	3

Each group's task is as following:

I Group

1. Why the solution of NaCl has electroconductivity, but sugar solution doesn't?
2. What sort of chemical bonds are possible for electrolytes?
3. Describe the chemical equation of electrolytic dissociation for NaCl .

II Group

1. Explain the following notion:
 - a) Cation
 - b) anion
 - c) cathode
 - d) anode
2. What is the role of relative permittivity (ϵ) of water between Na^+ and Cl^- in solution? Give explanation of Coulomb's Law in this situation.
3. There are three solutions in following flasks:
 - a) in the first flask: 4 moles of K_2SO_4
 - b) in the second flask: 12 moles of NaCl
 - c) in the third flask: 9 moles of $\text{Al}(\text{NO}_3)_3$

Complete electrolytic dissociation of salt take place in each flask. Prove that in the direction of $a \rightarrow b \rightarrow c$ amount of ions of salt to form arithmetic progression.

III Group

1. Explain existence of ions in cytoplasm of cell of biological creatures.
2. What is the reason of becoming warmer when strong H_2SO_4 is solved in water, but why we observe becoming colder when NH_4NO_3 is solved in water?
3. Why colour change is observed when dry CuSO_4 is solved in water?

For research is given limited definite time to the groups. I facilitate to the students as a scientific guide during this time. The pupils analyse directions of research: chemical properties of electrolytes, Ions of cytoplasm of cell, Coulomb's forces in solution of electrolytes and mathematical analysis of research. Consequently, students discover essence of the things about chemistry themselves.

6. Findings

When research is over the groups start to exchange their conclusions. Each group prepare the presentation on the computer. Leader of each group presents to all the students about own group's research on the activeboard. In the process of the integrative teaching I defined new pedagogical advances which ensure more effective integration between different subjects, skills in pupils, brains.

Referring to "Susan J.2010. A conceptual, Integrated Approach to Teaching Science. USA: Library of Congress Publication Press on page 92-96" the integrative teaching methods show that the pupils gain very useful superiority in the lesson in comparison with other methods.

Table 2. Comparison of the results of integrative teaching and other teaching methods

No	Integrative teaching	The other teaching
1	Increases pupils' abilities to analyze and easily understand cause-result relations between the different physic-chemical and biological processes, using the knowledge gained in different subjects.	The cause-result relations are very poor and the pupils mainly pay attention to the facts and try to remember the results of the stages. Referring to "Ahmadov H.H.2008. Pedagogy. Baku: Education Press on page 142" they cannot create relationships between the separate chemical processes.
2	My researches show that sufficiency is very high and I can save a lot of time (about 90 %) in teaching the topic)	Referring to "Norbert J.Melanie M.Thomas J.2005.Chemists, Guide to Effective Teaching. USA: Prentice Hall on page 88-90" sufficiency is low and quality of perceiving the topic is much lower than in integrative teaching.
3	The pupils tend to solve the problems by themselves and about 80% of the problems are solved independently, thus their inclination for creativity is extended.	In comparison with the integrative teaching students solve only about 30% of the problems.

7. Discussion

The pupils start to discuss the information they gained from their research. In this time I am very attentive, I pay special attention to the integration between different subjects (chemistry, biology, physics and math). For example, I ask the pupils then following questions in order to create integration. In this time I referring to Susan J.2010. A conceptual, Integrated Approach to Teaching Science. USA: Library of Congress – Press, McFadden.1997. Science Plus Technology and society-- level red, USA.:Holt Press, Eilks I. Hofstein A.2013.Teaching Chemistry.Rotterdam: Sense Publisher Press, Kumar S. 2004. Methods of Teaching Chemistry, New Delhi: Discovery House Press,Bluestein J. Cherry C. 2003. Skills for Successful Teaching,USA: Brighter Child Press, Bain K.2004. What the Best College Teachers Do. Cambridge, MA: Harvard University Press, Aliyev A.2008 .Chemistry Curriculum Conception.Baku: Education Press, Conover W.2010.Innovative Methods of Teaching and Learning Chemistry,USA-ACS publications, Frazee.B. 2000 .Integrated Teaching Methods. Delmar Publishers-Press, Barke.H.D.2012.Essentials of Chemical Education.Berlin:Heidelberg Press and Jones M. Jones. G. Acaster D. 1997.Chemistry. London: Cambridge university Press.

1. What sort of chemical bonds are possible for electrolytes and nonelectrolytes ?
2. What similarities and differences are there between electrolytes and other conductors?
3. What is the reason of electroconductivity of cytoplasm of cellule?
4. Why Coulomb's forces weaken between the ions when electrolyte is solved in water?
5. What ions exist in the cytoplasm of cellule?
6. What is the reason of electrolytic dissociation of salt in water?
7. What is the relative permittivity?
8. What is the role of relative permittivity (ϵ) of water between Cu^{2+} and SO_4^{2-} in solution?
9. Why the solution of CuSO_4 has electroconductivity, but glucose solution doesn't?
10. Why becoming warmer when strong H_2SO_4 is solved in

water?

11. What sort of chemical bonds are there between ions and molecule of water in solution?
12. Explain the connection between dissociation and hydratisations
13. What differences are there between cation and anion or cathode and anode?
14. Give explanation of Coulomb's Law comparative form between ions in dry salt and solution of salt in water.
15. Why becoming colder when NH_4NO_3 is solved in water?
16. What do you know mathematical analysis of amount of ions after electrolytic dissociation ?
17. What differences are there between chemical properties of electrolytes and nonelectrolytes ?
18. Explain existence of ions in cytoplasm of cellule of frog.
19. Are there ions in cytoplasm of cellule of human?
20. Describe the chemical equation of electrolytic dissociation for H_2SO_4
21. What differences electroconductivity of NaCl , CH_3COOH and sugar solution?
22. Give explanation is surrounded the ions by the water molecule in hydratisations process.
23. Why the salt has electroconductivity, when dry NaCl is melt?
24. Form the principal theses of electrolytic dissociation.
25. What significance of electrolytic dissociation for realizing other chemical process?
26. Why colour change is observed when dry CuSO_4 is solved in water?
27. What is the reason existence of ions in cytoplasm of cellule of biological creatures.
28. What sort of chemical bonds are possible for nonelectrolytes?
29. Why the solution of HNO_3 has electroconductivity, but sugar solution doesn't?
30. Attention following details, realizing and compare them:
 - a) Chemical properties of electrolytes, the dissociation of matter in water and the hydratisations of ions in water
 - b) Ions of cytoplasm of cellule and the cause of existence

of ions in cytoplasm of cellule

c) Coulomb's forces in solution of electrolytes, the cause of Coulomb's forces weaken between the ions when electrolyte is solved in water and the cause of electroconductivity of solution.

d) Mathematical analysis of research and mathematical analysis of result which is gained in research.

31. Why colour change is observed when dry CuSO_4 is solved in water?
32. What sort of chemical bonds are possible for electrolytes?
33. Describe the chemical equation of electrolytic dissociation for $\text{Ca}(\text{OH})_2$
34. What is the role of relative permittivity (ϵ) of water between K^+ and Cl^- in solution? Give explanation of Coulomb's Law in this situation.
35. There are three solutions in following flasks:
 - a) in the first flask: 2 moles of Na_2SO_4
 - b) in the second flask: 6 moles of KCl
 - c) in the third flask: 4,5 moles of $\text{Fe}(\text{NO}_3)_3$

Complete electrolytic dissociation of salt take place in each flask. Prove that in the direction of a→b→c amount of ions of salt to form arithmetic progression

8. Conclusions

After discussion the generalization is conducted by the pupils, if my help is required I assist my students. I try to create connection with actual life and practice by the use of integrative teaching method. Pupils construct following integrative scheme as a result and they referring to "McFadden.1997. Science Plus Technology and society--level red, USA::Holt Press on page 108-140" and "Norman.H. Cunningham J. 1999 .Chemistry Activities. California: Northridge Press on page 56-64" too.

Referring to "Jones M. Jones. G. Acaster D. 1997.Chemistry. London: Cambridge university Press on page 151-158" pupils can solve the sample tasks when they apply their skills into practice in creative form. Referring to "Taber K.2012. Teaching secondary chemistry,London: Hodder Education on page 74-78", "Kumar S. 2004. Methods of Teaching Chemistry, New Delhi: Discovery House Press on page 88-94", "Kumar S. 2004. Methods of Teaching Chemistry, New Delhi: Discovery House Press on page 72-79" and "İlyasov M.2013.Teacher,s Pedagogical Skills . Baku: Science and Education Press". I make evaluation of the students' activities with the following criteria at the end of the lesson.

Table 3. The results of the different directions of research

Topic	Subject			
	Chemistry	Biology	Physics	Math
Electrolytic dissociation	Chemical properties of electrolytes	Ions of cytoplasm of cellule	Coulomb's forces in solution of electrolytes	mathematical analysis of research
Details of process that the pupils have perceive	The dissociation of matter in water The hydratisations of ions in water	The cause of existence of ions in cytoplasm of cellule	The cause of Coulomb's forces weaken between the ions when electrolyte is solved in water The cause of electroconductivity of solution	mathematical analysis of result which is gained in research

Table 4. The criteria of evaluation of the students, skills in integrative teaching.

Criteria	I group	II group	III group
Can explain essence of electrolytic dissociation			
Can solve the task			
Can present the result of the research			
Can conduct the experiment freely			
Is disciplined and can work in cooperation			

I use selfevaluation and reflexion for the students at the end of the lesson too, referring to Aliyev A.2008 .Chemistry Curriculum Conception.Baku: Education Press, Conover W.2010.Innovative Methods of Teaching and Learning Chemistry.USA-ACS publications, Frazee.B. 2000 .Integrated Teaching Methods. Delmar Publishers-Press and Barke.H.D.2012.Essentials of Chemical Education.Berlin:Heidelberg Press Increases pupils' abilities to analyze and easily understand cause-result relations between the different physic-chemical and biological processes, using the knowledge gained in different subjects. My researches show that sufficiency is very high and I can save a lot of time (about 90 %) in teaching the topic).The pupils tend to solve the problems by themselves and about 80% of the problems are solved independently, thus their inclination for creativity is extended. In the integrative teaching process pupils are master of skills, what necessary for their life: 1) Students can compare electrolytes and nonelectrolytes systematically 2) Students can explain the essence of the electrolytic dissociation 3) Students can create connection between dissociation and hydratisations 4) Students can create connection between the facts connected with the conceptions of different subjects (chemistry, biology, physics and math) when they research electrolytic dissociation. 5) The selfevaluation skills are progress in pupil,s brain. 6) Teacher can create connection with actual life and practice by the use of integrative teaching method very easily. 7) Students can solve the task very easily. 8) Students can explain essence of chemical process deeply. 9) Students can present the result of the research perfectly. 10) Student can conduct the experiment freely. 11) Students are disciplined and can work in cooperation. Consequently, the integrative teaching helps the students as perfectly to perceive the laws of nature.

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