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Teaching the Inorganic Compounds with the Application of 2-d Code

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Abstract
The applications of 2-d code which can be applied as an alternative tool on naming the inorganic compounds which is one of the chemical subjects that the science students have difficulty to understand, and on writing the chemical formulas can be used to raise the students' motivation against the learning. 2-d code; has started to be popular with its properties such as its practical usage and quick working (Polat, 2014) and its application fields in the education are assessed within the scope of methods which are known as the mobile learning in the much more general meaning. In this sense, it is considered that it will facilitate the passing between the educational material through the mobile device with the printed learning material with the use of the 2-d code applications by the students. It was aimed to determine the effect of worksheets with the applications of 2-d code in teaching the inorganic compounds as one of the important subjects of chemistry to the science students with this research. The quasi-experimental design of pre and post-tests for the single group was used in the research. The study group consists of 47 science students in total who receive their training at 1st grade of Science Teaching in Ondokuz Mayıs University in Turkey. According to the answers which were given for the knowledge test, it was seen that there was a significant difference on behalf of the post-test, which the worksheets with the applications of 2-d code were used in teaching, between the pre-test success points which were obtained before the application and the post-test success points which were obtained after the application. According to the pre-test results of research, it was determined that the compounds of "KH (f=35) and ZnI_2 (f=32)" were written mostly in the correct form. Furthermore, it was seen that none of students wrote the following compounds in the correct form; "SO_3, $HBrO_3$, $CoCl_2.6H_2O$, KO_2, $HClO_2$, $NH_4H_2PO_4$, H_2CO_3 and NH_4HSO_3". When the correct answers which were given to the post-test of research were reviewed, it was determined that the compounds of "KH (f=41), $HgCl_2$ (f=38), ZnI_2 (f=36) and $CrCl_2$ (f=34)" were mostly written in the correct form. Moreover, it was seen according to the pre-test results of research that none of the students could write the compounds of "nickel nitrate, periodic acid, iodic acid, mercury (II) sulphate pentahydrate, hypocholorous acid, chloric acid, sulphurous acid, sodium thiosulphate, silver dichromate, sodium hydrogen phosphate, ammonium hydrogen phosphate and phosphorous acid". When the answers which were given to the post-test of research were reviewed, it was determined that the most ones were "rubidium hydroxide (f=39), potassium perchlorate (f=37) and hypocholorous acid (f=36); the least ones were "nickel nitrate (f=2), phosphorous acid (f=2), sodium thiosulphate (f=1) and ammonium hydrogen phosphate (f=1)". If a compound's chemical formula is known, the connections can be provided to be done between the main subjects of chemistry that the lesson will be done much more attractive with the technology integration in the chemistry teaching as it is considered that an opinion is given about the bond pattern while it is understood how many molecules are available in whichever atom.
Keywords: Science teaching, Inorganic compounds, Practice of 2-d code

1. Introduction

The compounds which are defined as the pure substances that two or more atom kinds come together and form them can be shown among the subjects that the students have difficulty to understand them (Demircioğlu & Demircioğlu, 2005). It was seen in the searches that the reasons of difficulty which have been seen in teaching the subject of "naming the chemical compounds" have been focused, and it has been aimed to teach the subject with the use of computer-aided learning methods (Turaçoğlu, 2009). It has been aimed in the computer-aided teaching to provide that the students reach the information whenever and wherever they want with the use of an android device, to raise their motivations and to provide their active participation into the lessons. One of the devices to be used in the android devices such as telephone, tablet, and computer is the applications of 2-d code to be used from the point of these purposes.

2-d code; has started to be popular with its properties such as its practical usage and quick working (Polat, 2014). The information which is put into the 2-d code can be easily accessible with a simple application which is downloaded into a smart mobile device. The application fields of 2-d code technologies in the education are assessed within the scope of methods which are known as the mobile learning in more general meaning. Ramsden (2008) stated how the use of 2-d codes with the cellphones will be used in the printed learning materials educationally. Akın (2014) concluded that the computer implement skills of students who use the 2-d

code-aided learning material increase, in his research that he reviewed the effect of 2-d code-aided learning material on the skill and continuance within the scope of the Information and Communication lesson. The online information sources with the 2-d code applications can be considered as the search engine which provides the information related to the subject to be searched. It is considered that the use of online information sources with the printed materials has a potential to increase the learning success in the educational field instead of taking their place (Özdemir, 2010).

When the role of teachers is considered in the use of computers effectively and efficiently in the class, it is aimed that a science teacher grows as a computer literate simply at the basic level. It is expected that a teacher can minimize the time lost which would occur in the possible lesson due to the technical faults and he/she can plan the teaching process in the best way. It was aimed to determine the effect of worksheets with the applications of 2-d code in teaching the inorganic compounds as one of the important subjects in the chemistry to the science students, with the research which was done in the sense.

2. Method

2.1 The Research Design

The quasi-experimental design of pre-test and post-test for the single group was used in the research.

2.2 The Study Group

The study group of research consists of 47 students in total who receive their training at 1st grade of Science Teaching in Ondokuz Mayıs University in Turkey.

2.3 The Data Collection Tools

The data collection tools which were used in the study as the following:

2.3.1 The Knowledge Test on Inorganic Compounds

It is a test that was developed to evaluate the students' knowledge by the researchers and that 100 inorganic compounds' chemical formulas and names were asked to be written. The chemical formulas of the inorganic compounds that their names were given at the first of 2 questions were asked to be written in the knowledge test and the names of inorganic compounds that their chemical formulas were given at the second one were asked to be written. The knowledge test which was prepared was used as the pre-test before the practice which was done within the scope of General Chemistry-I lesson, and as the post-test after the practice.

2.3.2 The Worksheet on Inorganic Compounds

The 2-d codes at the size *(4 cm x 4 cm)* were included in the worksheet which was prepared to teach the subject. 100 inorganic compounds which were commonly used in order to be included in the worksheet were determined. The worksheet which includes the 2-d codes that the formulas with these compounds were asked to be written and the worksheet which includes the 2-d codes that their names were asked to be written were prepared and presented discretely.

2.4 The Data Analysis

The correct answers which were given in the knowledge test by the students were evaluated as "1 point" and the incorrect or empty answers were evaluated as "0 point". The analysis of data which was obtained from the research was done with the use of SPSS statistical package program. As the size of group is the less one than 50, Shapiro Wilk test is used to review whether the test's points have a normal distribution or not. As a result of research, p value was calculated as .893 and it was determined that the data had a normal distribution. As a result of this analysis, as the data from the answers of knowledge test by the science students provides a normality assumption; the relation between the pre-test and post-test's points if the knowledge test was analyzed with the dependent samples t-test which is one of the parametric tests.

3. Findings

The results of dependent samples t-test for the answers that the science students gave to the pre-test and post-test's questions in the knowledge test of inorganic compounds were given at Table 1.

Table 1. The results of dependent samples t-test belonging to the students' pre-test and post-test

	N	$\bar{X}$	*s*	*t*	*p*
Pre-test	*47*	*14.55*	*10.274*	*-13.306*	*.000**
Post-test	*47*	*42.64*	*18.715*		

*p< .05

When the Table 1 is reviewed, there is a significant difference on behalf of the post-test success points that the worksheets with the applications of 2-d code were used in teaching, between the pre-test success points which were obtained before the practice and the post-test success points which were obtained after the practice.

[$t_{(46)}$=-13.306, p=.000, p<.05]. The arithmetic mean of pre-test points from the research was calculated as $\bar{X}$=14.55 and the arithmetic mean of post-test points was calculated as $\bar{X}$=42.64.

The frequency distribution of pre-test and post-test for the points of answers that the science students gave for the first question that they were asked to write the chemical formulas of the inorganic compounds that their names were given in the knowledge test were presented at Table 2.

Table 2. The frequency distribution of pre-test and post-test for the answers that the students answer for the first question

Formulas of the compounds	***Pre-test (f)***	***Post-test (f)***	***Formulas of the compounds***	***Pre-test (f)***	***Post-test (f)***
KH	*35*	*41*	*HI*	*12*	*30*
$HClO_2$	*0*	*32*	*$Zn(NO_2)_2$*	*6*	*15*
HNO_2	*1*	*26*	*$Mg(NO_3)_2$*	*13*	*30*
ZnI_2	*32*	*36*	*$HgCl_2$*	*26*	*38*
H_2SO_4	*15*	*31*	*$Ca_3(PO_4)_2$*	*10*	*28*
FeS	*9*	*28*	*CoI_2*	*13*	*15*
Cu_2O	*12*	*25*	*CsF*	*12*	*26*
HNO_3	*10*	*28*	*$CrCl_2$*	*19*	*34*
Cu_2CrO_4	*7*	*10*	*$NH_4H_2PO_4$*	*0*	*13*
BCl_3	*1*	*14*	*$Mg(HSO_3)_2$*	*2*	*18*
PCl_5	*3*	*15*	*H_2CO_3*	*0*	*8*
SF_6	*4*	*23*	*ZnS*	*13*	*23*
SO_3	*0*	*18*	*CS_2*	*3*	*12*
NaClO	*3*	*22*	*Mn_2SO_3*	*1*	*15*
KCl	*4*	*29*	*SnO_2*	*1*	*4*
$NaClO_3$	*5*	*30*	*CaC_2O_4*	*1*	*13*
ICl	*1*	*7*	*NH_4HSO_3*	*0*	*18*
ClF_3	*1*	*17*	*$HBrO_3$*	*0*	*15*
$Ca(ClO)_2$	*1*	*11*	*H_2S*	*9*	*17*
Ag_2CO_3	*4*	*27*	*$CoCl_2.6H_2O$*	*0*	*24*
$K_2Cr_2O_7$	*5*	*24*	*KNO_3*	*19*	*33*
KO_2	*0*	*10*	*$Fe(OH)_3$*	*18*	*33*
$Mg_3(PO_4)_2$	*11*	*28*			

When the Table 2 was reviewed, it was determined that the compounds of "KH (f=35) and ZnI_2 (f=32)" were mostly written in the correct form by the results of pre-test of research. Moreover, it was seen that none of the compounds of "SO_3, $HBrO_3$, $CoCl_2.6H_2O$, KO_2, $HClO_2$, $NH_4H_2PO_4$, H_2CO_3 and NH_4HSO_3" was correctly written the students. When the correct answers which were given to the post-test of research were reviewed, it was determined that the compounds of "KH (f=41), $HgCl_2$ (f=38), ZnI_2 (f=36) and $CrCl_2$ (f=34)" were mostly written correctly. The frequency distribution of pre-test and post-test for the points of answers that the science students gave for the second question that the names of inorganic compounds that their chemical formulas were given in the knowledge test were asked to be written was presented at the Table 3.

Table 3. The frequency distribution of pre-test and post-test for the answers that the students answer for the second question

Names of the compounds	***Pre-test (f)***	***Post-test (f)***	***Names of the compounds***	***Pre-test (f)***	***Post-test (f)***
calcium hydride	*19*	*25*	*sulfurous acid*	*0*	*16*
hypocholorous acid	*0*	*36*	*aluminium sulphur*	*12*	*23*
aluminium fluoride	*14*	*26*	*mercury (I) bromide*	*5*	*8*
chloric acid	*0*	*30*	*trihydrogen mononitride*	*2*	*6*
silver chloride	*19*	*26*	*strontium sulphate*	*2*	*5*
magnesium bromide	*25*	*31*	*ıron (III) oxide*	*12*	*23*
perchloric asit	*1*	*30*	*ıron (III) sulphide*	*5*	*10*
sodium sulphide	*10*	*21*	*ammonium acetate*	*2*	*12*
lithium nitride	*6*	*19*	*ammonium carbonate*	*7*	*14*
barium acetate	*1*	*8*	*ammonium sulphide*	*5*	*16*
chrome (III) sulphur	*10*	*21*	*ammonium nitride*	*7*	*26*
phosphoric acid	*2*	*9*	*ammonium phosphate*	*6*	*18*
aluminium oxalate	*2*	*8*	*sodium thiosulphate*	*0*	*1*
rubidium hydroxide	*15*	*39*	*mercury (II) cyanide*	*5*	*24*
potassium permanganate	*12*	*26*	*ıron (II) sulphate*	*10*	*22*
silver dichromate	*0*	*8*	*sodium hydrogen phosphate*	*0*	*7*
potassium perchlorate	*4*	*37*	*calcium bicarbonate*	*5*	*13*
nickel nitrate	*0*	*2*	*potassium bisulphate*	*7*	*17*
copper (I) nitrite	*4*	*27*	*periodic acid*	*0*	*13*
ammonium chromate	*1*	*8*	*caesium sulphate*	*3*	*13*
ıodic acid	*0*	*10*	*chrome (III) oxide*	*12*	*23*
chrome (III) hydroxide	*6*	*31*	*oxygen difluoride*	*16*	*29*
copper (II) sulphate pentahydrate	*0*	*22*	*sodium acetate*	*2*	*10*
hydrogen peroxite	*6*	*13*	*magnesium fluoride*	*17*	*31*
chrome (III) sulphate	*5*	*22*	*aluminium hydroxide*	*14*	*26*
lithium cyanide	*5*	*30*	*ammonium hydrogen phosphate*	*0*	*1*
phosphorous acid	*0*	*2*	*aluminium phosphate*	*17*	*26*
sodium dichromate	*2*	*10*			

When the Table 3 was reviewed, it was seen that none of the students could write the compounds of "nickel nitrate, periodic acid, iodic acid, mercury (II) sulphate pentahydrate, hypocholorous acid, chloric acid, sulphurous acid, sodium thiosulphate, silver dichromate, sodium hydrogen phosphate, ammonium hydrogen phosphate and phosphorous acid", by the results of pre-test of research. When the correct answers for the post-test of research were reviewed, it was determined that "rubidium hydroxide (f=39), potassium perchlorate (f=37) and hypocholorous acid (f=36)" were the most ones; "nickel nitrate (f=2), phosphorous acid (f=2), sodium thiosulphate (f=1) and ammonium hydrogen phosphate (f=1)" were the least ones.

3. Conclusion and Discussion

As a result of research, the lesson was tried to be done as much more attractive with the technology integration in the chemistry teaching. So, according to the answers for the knowledge test, it was seen that there was a significant difference on behalf of the post-test that the worksheets with the applications of 2-d codes were used in teaching, between the pre-test success points which were obtained before the practice and the post-test success points which were obtained after the practice [$t_{(46)}$=-13.306, p=.000, p<.05]. This result reveals that this research which was conducted with the mobile learning increases the interest, motivation and academic success of students on writing the inorganic compounds' chemical formulas and their names. The reasons of the mobile learning's positive effects on the learning can be shown as the mobile devices are carried easily; they are used with the teaching materials such as a book, notebook and worksheets, and they provide the advantages such as the active learning. In this sense, the applications of 2-d code are the applications to facilitate that the students have contact with the printed learning material such as a book, notebook and worksheets and the mobile devices. So, Acartürk (2012) stated that the integrated usage of 2-d code technologies and the mobile devices that these technologies are used with the printed educational material revealed the potential to increase the learning success. When the literature reviewed is done, the students use the mobile devices and the 2-d code technology in order to give a feedback in the lesson for the development of lesson (Susono & Shimomura, 2006), two-dimentional (2-d) code technologies create an awareness in the potential usage fields in the education (Acartürk, 2012) and there

are the searches how the teachers and students are to use this technology in the educational and training processes in the classroom (Çataloğlu & Ateşkan, 2014). The use of 2-d code applications which are used in teaching the inorganic compounds in the classroom are evaluated as a step to meet today's students' interest and expectation, and to be incentive for them to learn the chemistry subjects.

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