Available online at www.sciencedirect.com

ScienceDirect

Procedia - Social and Behavioral Sciences 116 (2014) 4742 – 4747

Procedia
Social and Behavioral Sciences

5th World Conference on Educational Sciences - WCES 2013

Examining Biology Teachers Candidates' Scientific Process Skill Levels and Comparing These Levels in Terms of Various Variables

Sevilay Erkol* ilker Ugulu

Biology Department, Necatibey Faculty of Education, Balikesir University, 10100, Balikesir-Turkey

Abstract

It is very important to develop students science process skills which have considerable role in educational settings in order to facilitate students' learning abilities, support their critical thinking skills and make them competent in research ways and methods in science and social sciences. One of the most useful steps to promote scientific process skills is to train teachers which have gained these skills. In this aspect, the aim of this study is to determine the biology teacher candidates' levels of scientific process skills and to compare the different variables. For this reason, Scientific Method Abilities Test (SMAT) which has 36 multiple choice questions,is applied to 121 biology pre-service teachers enrolling in Necatibey Faculty of Education of Balkesir University. The results of this study show that scientific process skill levels of pre-service biology teachers' need to be developed and that there are no statistically significant difference between pre-service in terms of gender and age, except there is for the class level. When theresults of the study compared to other similar studies, it can be regarded that science process skill levels of biology student teachers' is in an intermediate level (20, 43) which is lower than other studies.

*Keywords:*Scientific process skills, Biology teacher candidates, The scientific methods abilities test

1. Introduction

"The Knowledge Society" which can be defined as the highest point of social development provides people to reach information they need in order to improve themselves (Kocacik, 2003). But as scientific knowledge increases rapidly day by day parallel with technologic development, there is a growing need for individuals who research, observe and are able to be adapted with this increasing developments instead of those individuals who have ordinary mind and hand skills, and those who wait for knowledge to come to them directly (Karahan, 2006). In order compensate this need, individuals should be taught how to think in the light of science rather than merely memorize the information (Cerit and Berber, 2008). The aim here is not growing up every student to be a pure scientist but providing them a multi-dimensional thinking as a scientist do (Duran and Ozdemir, 2009). In order to achieve this goal, science process skills play an important role by providing students to produce scientific knowledge as well as to learn nature of science by doing and experiencing.

*Corresponding Sevilay ERKOL. Tel.: +90-554-247-1168
E-mail address: sevilayerkol@gmail.com

doi:10.1016/j.sbspro.2014.01.1019

Scientific process skills can be defined as the basic skills that make learning easier, that develop students' readiness to take responsibility, increase the memorability of what they learned and make students learn research methods and approaches along with being active in the domains of sciences and social sciences (Ayas, Cepni, Johnson and Turgut, 1997). Scientific process skills are also described as the abilities that scientists use during their works and also the competencies displayed while solving a scientific problem (Monhardt and Monhardt, 2006). Considering this point, the scientific process skills are the basic information producing and regulating skills related to the world around us, and therefore the most important mean to achieve the information society (Ayas, Cepni and Akdeniz, 1993).

If we analyze the research of science process skills, we can observed that they are classified in different ways.Generally, science process skills are surveyed on two sub-headings; the basic process skills and the science process skills (Donmez and Azizoglu, 2010). Unified process skills are divided into two segments as Experimental Process Skills and Causal Process Skills in itself. However, the science process skills are divided into the Basic process skills and Experimental Process Skills according to the framework of the Ministry of National Education "Curriculum Elementary Science and Technology". Within these skills, the basic process skills; consist of observation, measurement, classification, prediction, inference and communication whereas experimental process skills consist of model building skills such as identifying and controlling variables, hypothesis formulation and testing, data interpretation, tap the definition of work, making the experiment (BagciKilic, 2006). These skills are the most influential outcomes of the correct interpretation of events and education programs which are used in every stage of scientific studies such as in chemistry, physics and biology of Natural Sciences.

In teaching-learning process, it's very important to train teachers who acquire the scientific process skills, especially in the area of Science with reason to improve the skills of students (Bluhm, 1979: 445). In case teachers which have obtained these skills, solely in pre-service education be acquiring of basic skills such as critical thinking, creative thinking, making scientific research likewise be trained with how to teach up skilling to own students (Akar, 2007). In this way, the teacher candidates' levels of scientific process skills and determined variables that affect this level are important with regard to built up the deficiencies which are required in this subject.

2. Methods

2.1. Model of the research

This study was conducted to determine whether the teacher candidates' levels of scientific process skill according to gender, age and grade variables of this skill levels are a significant descriptive study of single-scan model.

2.2. Working group

Working group of this study constitutes 121 teacher candidates of the Department of Biology Necatibey Faculty of Education at Balikesir University in the 2011-2012 academic year, spring semester (89 female, 32 male). Teacher candidates that constitute working group are 28 of the first, 28 of the second, 29 of the third, 14 of the forth and 24 of the fifth- grade students. Teacher candidates' ages range from 18 to 25 and also 20 year-old candidates who participated in the study are majority (29 person % 24.0).

2.4. Data collecting tool

As data collecting tool was used the Scientific Method Abilities Test (SMAT) that is formed from 36 multiple-choice questions which were developed by Burns, Okey, and Wise (1985) and were adapted by Bahar and Ates (2002) to Turkish. Bahar and Ates (2002) adapted the reliability coefficient of scale using the Spearman- Brown correction formula that was found 0.76. The subscale of the test and the number of questions in each sub-scale are as follows: "Identifying and controlling variables" (12), "identification by making" (6), "establishment of hypothesis" (9), "Data analysis and drawing graphic" (6), and "experimentation". In addition, independent variables of the study

about questions such as the participants name, surname, age, gender, class have in personal information takes part in the test.

2.5. Data analysis

The data obtained from Scientific Method Abilities Test (SMAT) were transferred to computer and were analyzed with the SPSS 17.00 package program. Teacher candidates' levels of scientific process skills were investigated significantly by regards to personal characteristics whether differed or not. The t-test was used for two variable characteristics and ANOVA was used for more than two characteristics. If the ANOVA test results any significant difference between the groups, the source of this difference will be determined by Scheffe test.

3. Findings

Teacher candidates' levels of scientific process skills and determining the variables that affect these levels are very important for elimination of deficiencies in the infrastructure of this subject. In this context in accordance with purpose of this study, mean scores' from Scientific Method Abilities Test (SMAT) and subscale results of this test that obtain a statistical information of teacher candidates will be presented in tables.

3.1. Findings related to the results of the teacher candidates' scientific method skills test

In working group of the students that was evaluated totally 36 points (question per point) received an average of 20.43 from scientific method skills test. This value shows that the students answered only % 56, 75 of all questions in test. This means that scientific process skills of teacher candidates' should be developed.

Teacher candidates', had a mean score of 7,24 in subscale of "Identifying and controlling variables", 3,33 in subscale of "identification by making", 4,87 in subscale of "establishment of hypothesis", 3,87 in subscale of "data analysis and drawing graphic" and 1,12 in subscale of " experimentation" of the scientific method abilities test. These values are close to each other and the subscale of "data analysis and drawing graphic" has the highest level of success.

Evaluation of averages according to terms of grade level of teacher candidates' levels of scientific process skills, averages of students in class 2^{nd} and 5^{th}(X_2=17.08 and X_5= 16.75) were lower than average overall mean. At the same time, evaluation of scientific process skill levels according to age variable of teacher candidates' gives us a contrary expectation. With increasing of the age of teacher candidates' the levels' of scientific process skills decreased. Candidates participating in this study were between 18-20 ages of levels', the average of these ages was 21, between 21-23 age of levels' average was 20 and between 24-25 age of levels' average was 19.

3.2. The results of scientific methods abilities test (smat) of the teacher candidates' comparison with independent variables

Biology teacher candidates' levels of scientific process skills in the subscale "Identifying and controlling variables","identification by making", "establishment of hypothesis", "data analysis and drawing graphic" and " experimentation" in comparison by gender weren't statistical meaningful (p <0,05).

Table 1: Comparison T-Test with Gender Variables of Biology Candidates' Levels of Scientific Process Skills

	Gender	N	Item Number	Mean	SS	p
1-Identifying and controlling variables	Male	32	12	6,84	2,81	0,281
	Female	89		7,38	2,26	
	Total	121		7,24	2,41	

2-Identification by making	Male	32	6	3,34	1,51	0,945
	Female	89		3,33	1,17	
	Total	121		3,33	1,26	
3- Establishment of hypothesis	Male	32	9	4,69	2,16	0,530
	Female	89		4,93	1,78	
	Total	121		4,87	1,88	
4- Data analysis and drawing graphic	Male	32	6	3,78	1,26	0,621
	Female	89		3,90	1,11	
	Total	121		3,87	1,15	
5- Experimentation	Male	32	3	1,19	0,90	0,612
	Female	89		1,10	0,80	
	Total	121		1,12	0,82	

Teacher candidates levels of scientific process in terms of grade level is examined through ANOVA test and by the results of this test we can say that they are statistically significant at the ,05 confidence level and for all subscales of SMAT is shown in Table 2.

Table 2: ANOVA Test Results of Scientific Process Skill Test According to Grade Levels

	Grade	N	Mean	ss	F	p	Difference Between the Groups
1-Identifying and controlling variables	**1.**	28	7,68	1,92	7,640	,000*	3-2 4-2 3-5 4-5
	2.	26	6,11	2,25			
	3.	29	8,34	2,04			
	4.	14	8,57	2,14			
	5.	24	7,24	2,57			
2-Identification by making	**1.**	28	3,79	,995	7,927	,000*	1-2 1-5 3-2 4-2 3-5
	2.	26	2,58	1,14			
	3.	29	3,86	0,95			
	4.	14	3,79	1,25			
	5.	24	2,71	1,40			
3- Establishment of hypothesis	**1.**	28	5,39	1,66	4,557	,002*	1-2 1-5 3-2 4-2 3-5
	2.	26	4,07	1,94			
	3.	29	5,31	1,58			
	4.	14	5,78	1,84			
	5.	24	4,04	1,92			
4- Data analysis and drawing graphic	**1.**	28	4,35	0,83	9,500	,000*	1-5 4-2 3-5 4-5
	2.	26	3,54	1,24			
	3.	29	4,06	1,03			
	4.	14	4,64	0,63			
	5.	24	2,96	1,08			
5- Experimentation	**1.**	28	1,25	0,84	1,985	,101	
	2.	26	0,77	0,76			
	3.	29	1,10	0,82			
	4.	14	1,43	0,93			
	5.	24	1,21	0,72			

ANOVA analysis is also applied to this research to find out if there is any significant difference between subscales of "Identifying and controllingvariables," “identification by making," "Establishment of Hypothesis", "data analysis and graphing" and "experimentation" and grade level.

When levels of scientific process are compared to teacher candidates in terms of age, from Table 3 below can be seen that there are statistically no significant difference (p<,05) between these age groups.

Table 3: ANOVA Test Results of Teacher Candidates' Levels of Scientific Process According to Age

	Age	N	Mean	SS	F	p	Difference Between the Groups
1-Identifying and controlling variables	18-20	44	7,41	2,35	1,121	,329	No difference
	21-23	56	7,37	2,27			
	24-25	21	6,52	2,85			
2-Identification by making	18-20	44	3,34	1,21	,069	,933	No difference
	21-23	56	3,35	1,24			
	24-25	21	3,28	1,44			
3- Establishment of hypothesis	18-20	44	5,06	1,94	1,111	,333	No difference
	21-23	56	4,91	1,60			
	24-25	21	4,33	2,37			
4- Data analysis and drawing graphic	18-20	44	4,06	1,18	1,140	,323	No difference
	21-23	56	3,78	1,05			
	24-25	21	3,66	1,27			
5- Experimentation	18-20	44	1,18	0,78	2,678	,073	No difference
	21-23	56	0,96	0,87			
	24-25	21	1,42	0,67			

4. Discussion

When we examine researches done in Turkey related to scientific process skills and variables effecting these skills, is seen that there are many studies made on teacher candidates as working groups (Ates and Bahar, 2002; Turkmen and etc., 2006; Demir, 2007; Ercan, 2007; Akar, 2007). Akar (2007) in his thesis that conducted with primary school teacher candidates concerning TIPS II test result found the candidates' mean score of scientific process skills as 23,54. Similarly, with TIPS II test of Turkmen and others (2006) and Demir's (2007) study with primary school teacher candidates' found the result of mean score as 24,60 and 27, 81 respectively. In Ates and Bahar's (2002) study with primary school teacher candidates' science process skill levels were indicated as medium level. If we compare this study of biology candidate teachers' scientific process skill levels and variables effecting these levels with the findings of previous studies it is found that biology teacher candidates' level of scientific process skills are in medium level with the score of 20, 43 and it is lower than the scores of other study groups which were stated before.

The results of this study shows that scientific process skill levels have no statistically significant difference in terms of gender. In Ercan's (2007) study, gender factor had no significant difference on teachers' scientific process levels and this finding seemed to support our findings. Similarly, the results of the studies which were made on primary school candidates showed that gender had no significant difference in any subscale of SMAT (Temiz, 2001; Demir, 2006; Turkmen, 2006; Akar, 2007). However, in Ates andBahar's (2002) study the pre- and post-test mean scores of TIPS II test showed a significant difference in favor of males. In terms of age variable, no significant difference was found between teachers candidates participated in the study.

5. Conclusion and Recommendations

The results of this study which aimed to reveal biology pre-service teachers' scientific process skill levels and variables affecting these levels can be drawn in this way; scientific process skill level of 121 biology teacher

candidates who participated in this study is in medium level. There is no significant difference between male and female teacher candidates. 1st, 3rd and 4th grade teacher candidates' levels of scientific process are higher than 2nd and 5th grades' levels with the subscales. Also, there is no significant difference for scientific process skills of teacher candidates in terms of grade level and age.

In future the new studies should be made related to the results of this study; it can be suggested for teacher training departments to give importance to scientific process skills with the help of activities such as argumentation, investigation, travelling, observation and experimenting. In addition, by considering teacher candidates' learning styles, could be made new investigations on how and in which way these styles and majors effect the levels of scientific process. Since Turkey's new education system has no precise distinctions to choose a university department anchored in high school graduation areas of students, there are differences between high school graduation areas and university preferences at the end of this process. Also there could be made a study related to scientific process skills of teacher candidates enrolled in departments such as social sciences and literature can be compared to biology, physics, and chemistry teacher candidates.

Training for acquiring scientific process skills has to start before elementary and high school, at the preschool age. For example Monhardt and Monhardt (2006) used pictorial books to get involved in children's world with a more familiar way and develop their scientific process skills. With this effort, children can easily make an interconnection between their real world experiences and their teachers' knowledge. Being late for developing scientific process skills for students would occur problems in achieving success not only in their daily lives but also in their education lives.

References

Akar U. (2007).*The relationship between student teachers' scientific process skills and critical thinking skills*.(Unpublished Master dissertation).AfyonKocatepe University, Afyon.

Ates, S. &Bahar, M. (2002). Approach to investigativescience thoughtdeveloping skills ofscientific method of 3rd grade studentsindepartment of primary school teaching. *5th NationalScience and MathematicsEducation Congress*,16-18 September 2002, Middle East Technical University, Ankara.

Ayas, A., Cepni, S., & Akdeniz, A.R. (1993). Development of the Turkish secondary science curriculum. *Science Education*, *77*(4), 433 - 440.

Ayas, A., Cepni, S., Jhonson, D., & Turgut, M.F. (1997). *Chemistry Teaching.* Ankara: Institute of Higher Education/World Bank, Pre-ServiceTeacher EducationNational Education Development Project.

BagciKilic, G.(2006). *Primary schoolscience thought*.Morpa Publications, Istanbul, 167p.

Cerit Berber N. (2008).*Business-power-energy-analogical models,conceptual change of teaching the subject ofthe realization the pedagogicaleffect: Konya Province example*.(Unpublished doctoral dissertation).Selcuk University, Konya.

Demir, M., (2007). The f*actors affectingpre- service primary teachers'adequacies on science processskills*.(Unpublished doctoral dissertation).Gazi University, Ankara

Donmez, F. & Azizoglu, N. (2010). Investigation of the students' science process skill levels in vocational schools: A case of Balikesir.*Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education,*4 (2), 79-109.

Duran, M. &Ozdemir,O.(2009).A qualitative study on the effect of learners' scientific processing skills on their attitudes towards science.*1st InternationalCongress of Educational Research*,Canakkale 18 March University, Canakkale

Ercan, S. (2007). *Science process skillslevels ofprimary school teachers'self-efficacylevels inscience.*(Unpublished master dissertation). Afyonkarahisar Kocatepe Universty, Afyonkarahisar.

Karahan, Z. (2006).*With in the science and technology lesson, the effects of scientific process skills based learning on learning products*.(Unpublished doctoral dissertation).ZonguldakKaraelmas University, Zonguldak.

Kocacik, F. (2003).Information societyand Turkey.*Magazine of Social Sciences*, 27/1, 1-10

Monhardt, L.&Monhardt, R. (2006). Creating a contextforth a learning of scienceprocessskillsthrough Picture books. *EarlyChildhoodEducationJournal*, 34, 67-71.

Temiz, B. K. (2001). *1st High schoolphysics classteachingprocess skillsdevelopmentprogrammescientificinvestigation into the suitabilityof students*. (Unpublished master dissertation).Gazi University, Ankara.

Turkmen, L., Ercan, S. & Suren, T. (2006) .Scientific skill levels of teacher candidates studying in last grade students.*XV. National Congress of Educational Sciences*, 13–15 September 2006, Mugla University: Muğla.